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Investigation of an Outbreak of Acute Febrile Respiratory Illness Among Recruits at Lackland Air Force Base, TX

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A large sustained outbreak of febrile respiratory illness (FRI) began in the Fall of 1999 among basic trainees at Lackland Air Force Base, Texas. Adenovirus was quickly identified as the predominant etiologic pathogen; every isolate typed was found to be type 4. Although the use of the oral adenovirus vaccine had been discontinued at Lackland AFB in 1989, this report documents the first outbreak among Air Force trainees since before the vaccine era. Historical records of respiratory illness occurrence among trainees indicated that this was clearly a new, large outbreak. Over a nine-month period, 1,371 trainees were hospitalized with FRI at a direct cost estimated at $898,000. The mean maximum oral temperature of hospitalized trainees was 102.4F and the mean length of stay was 2.7 days, showing that the morbidity was not trivial. An adenovirus carriage prevalence of 16.6% was found among "well" trainees. Among seroconverters, 43% had no record of seeking medical care during basic training. Self-reported personal hygiene practices were found to be wanting. A number of potentially effective interventions were recommended, none of which were felt to be likely to significantly impact the occurrence of adenovirus-related FRI other than the resumption of administration of an effective vaccine.

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Introduction

On April 4, 2000, the Commander of the 59th Medical Wing (59 MDW) at Lackland AFB TX formally requested that the Force Health Protection and Surveillance Branch of the Air Force Institute for Environment, Safety, and Occupational Health Risk Analysis (AFIERA/RSRH) conduct an investigation of an outbreak of acute febrile respiratory illnesses (FRI) among Lackland's basic trainee population. By the time of this request, the outbreak had been ongoing for about 5 months and the etiologic agent was known to be adenovirus. Basic public health intervention recommendations had not yielded a decrease in the number of new cases. The commander asked for an external review of the situation and for any additional recommendations that might decrease the incidence of FRI. This report details the findings of the outbreak investigation and resulting intervention recommendations.

Investigation description

Personnel from AFIERA/RSRH conducted the following studies with the cooperation and assistance of personnel from the 37th Training Wing (37 TRW), 59 MDW, and the Epidemiological Surveillance Division (AFIERA/SDE). The objectives of the investigation were to discover the extent of the problem and identify potential interventions. As the investigation progressed, 11 identifiable work efforts unfolded, each of which is described briefly below.

Establishing the existence of an outbreak. An attempt was made to determine whether there was a changing pattern of clinic visits for ambulatory respiratory illness among trainees. Historical data from the 59 MDW Public Health Office were analyzed along with electronic records from the Ambulatory Data System (ADS). There was an obvious, dramatic, and sustained increase in the respiratory illness rate starting in October 1999, clear evidence of a significant change from baseline.

Ongoing surveillance of FRI activity. FRI hospitalizations were tracked by 59 MDW personnel using a hand-kept log designed at the onset of the outbreak, followed by electronic hospitalization records available as of late April 2000. Throat cultures were obtained from most trainees to monitor pathogen activity. The number of hospitalized trainees peaked during April and May 2000. A curious pattern emerged, with hospitalization rates peaking approximately every 3-4 weeks. Hospitalization rates were inconsistently dependent on admission criteria policy, and by the Fall of the year 2000 the numbers had decreased to levels that justified the closing of the special ward.

Adenovirus prevalence estimation. It was unknown how prevalent adenovirus was in the non-hospitalized trainee population. The point prevalence of adenovirus carriage was evaluated by culturing a cohort of nonhospitalized trainees on 7 May. Of these generally healthy trainees, 16.6% had throat cultures positive for adenovirus. Neither presence of self-reported symptoms nor signs of upper respiratory infection on cursory physical examination were associated with

adenovirus positivity. The high prevalence indicated the pervasive nature of adenovirus within this population.

Severity of the clinical syndrome. Investigators reviewed 352 inpatient medical records of trainees admitted to Wilford Hall Medical Center (WHMC) and abstracted recorded clinical and demographic information. The review showed that the mean and median maximum oral temperature was 102.4F. After fever, the most frequent symptom was sore throat, followed by cough and headache. The febrile illness caused by adenovirus was more than just a "simple cold."

Personal hygiene practices among trainees. Four hundred ninety-three trainees and instructors completed a self-administered questionnaire. Most comments indicated widespread poor personal hygiene practices. The trainees turned off the water to many of the dormitory sinks to avoid cleaning details, a practice that limited the availability of handwashing facilities. The use of facial tissue was limited by the training culture that did not allow extraneous materials to be visible. While the contribution of these and other hygiene practices to adenovirus infection or transmission could not be ascertained, the findings did show considerable room for improvement in basic personal hygiene among the trainees.

Indoor air quality assessment. Because adenovirus is transmitted by droplet spread, an assessment of the quality of indoor air was undertaken. Simultaneous measurements of carbon dioxide (CO_2), temperature, and relative humidity were taken in four classrooms and four sleeping areas. During occupancy of the rooms, all four classrooms exceeded recommended CO_2 levels whereas only one sleeping area exceeded the recommended level. These results indicate that the quality of indoor air in the classrooms was poor, at levels leading to degradation of learning ability of the room occupants. The association between poor indoor air quality and adenovirus transmission was not directly assessed.

Extent of crowding in the training environment. Patterns of crowding of trainees were evaluated. Adenovirus-related FRI outbreaks appear to occur primarily in military training camps, where many people are housed and taught in close proximity. Living space per person was calculated by dividing the amount of living space by the number of trainees per flight. Based on available dormitory space and according to DoD standards for living space, no more than 54 trainees should be assigned to a flight. In times of increased numbers of trainees, however, this level could easily be exceeded, leading to more crowding. No standards could be found for classroom occupant density.

Seroconversion. To determine the number of recruits who entered basic training without evidence of exposure to adenovirus, but left basic training with serologic evidence of exposure, serum specimens from 126 trainees taken within the first few days of training and again after completion of training were analyzed for evidence of adenovirus antibodies using compliment fixation techniques. Seroconversion status was compared to healthcare-seeking behavior. Of the 126 trainees, 39% showed definite seroconversion and 43% of those had no electronic evidence of having sought medical care during the training period. These data indicate that this cohort was widely exposed to adenovirus and that many did not seek care as a result of that exposure.

Risk factors for hospitalization and adenovirus infection. Data on the total number of clinic and Emergency Department (ED) visits during basic training were gathered for a defined cohort of trainees. These data allowed an evaluation of the role of clinic settings in transmission of FRI and an examination of the influence that prior respiratory visits had on subsequent inpatient admission. The number of respiratory and non-respiratory visits during basic training was analyzed using hospitalization as a surrogate for the occurrence of a FRI. The analysis indicated that younger recruits and females were more likely to be hospitalized. Non-respiratory visits were inversely associated with hospitalization. However, a number of methodologic weaknesses limit the usefulness of this information.

Economic impact. A cursory evaluation of costs was undertaken to document the economic impact of the adenovirus outbreak. Average hospitalization costs were determined using Medical Expense and Performance Reporting System (MEPRS) data. An estimate of the cost of lost training was provided by 37th Training Wing personnel. Including only direct hospital and lost training costs, each hospitalization was estimated to cost $655. During this time period of 24 Nov 99 through 30 Aug 00, there were 1,371 admissions, costing an estimated $898,000.

Intervention recommendations. Recommendations for non-vaccine interventions were presented to the 59 MDW and 37 TRW leadership. A number of specific recommendations fell into nine categories: hygiene, indoor air quality (IAQ), ongoing surveillance, vaccine advocacy, fomite antisepsis, access to care, cohorting, and other considerations.

Conclusion. Adenovirus infections were found to be widespread in the basic training population of Lackland AFB. The number of cases represents a significant burden of morbidity and economic cost. Infection with adenovirus caused a wide range of symptom severity. Interventions focused on symptomatic individuals are likely to miss many who are infected and probably contagious. Interventions that are likely to be effective are those that can be universally and regularly applied to the basic trainee population. Vaccination remains the single intervention most likely to succeed in controlling this pathogen.

INTRODUCTION

On 4 April 2000, the Force Health Protection and Surveillance Branch of the Air Force Institute for Environment, Safety, and Occupational Health Risk Analysis (AFIERA/RSRH) was asked by the Commander of the 59th Medical Wing, Lackland AFB, Texas, to evaluate acute febrile respiratory illnesses among the basic trainee population (see Appendix A). The outbreak had been ongoing since October 1999, when a dramatic increase in the number of trainees seeking medical care for respiratory illnesses was noted. A new observation ward had been opened within Wilford Hall Medical Center (WHMC) on 24 November 1999. 59MDW personnel had already established the etiologic agent: adenovirus was recovered from the majority of the hospitalized trainees and typing of selected isolates yielded type 4 adenovirus in every isolate tested. A handwritten log of hospitalized trainees had been initiated and a weekly epidemiologic curve was being published showing the number of admissions starting from 24 November 1999. Recommendations regarding personal hygiene had been made to the training community. Despite these steps, the outbreak was apparently continuing and even accelerating through April 2000.

Coincident with the adenovirus outbreak was the emergence of streptococcal infections among recruits beginning in early November 1999. In particular, the presence of mucoid strains of Group A streptococcus led to the mass prophylaxis of all trainees with benzathine penicillin (or erythromycin for those allergic to penicillin), starting on 30 November 1999.

A team of 12 personnel from AFIERA/RSRH was organized to participate in various phases of the ensuing investigation. The team worked in close coordination with numerous personnel from both the 37 TRW and the 59 MDW as well as the AFIERA/SDE, the clinical reference laboratory on Brooks AFB. Key contact personnel are listed in Appendix B.

HISTORICAL BACKGROUND

Lackland AFB in San Antonio, TX is the only USAF basic training site. During the 6-week basic training period, trainees are organized into 6 basic training squadrons with 10-12 flights per squadron and an average of 55 trainees per flight, depending on the number of incoming trainees. There are approximately 3,500 to 5,000 basic trainees at any one time with higher numbers of recruits during the summer. As is typical of military basic training environments, Lackland trainees are housed and educated in close quarters and have a very busy, regimented schedule.

Acute febrile respiratory illnesses (FRI) commonly occur in military basic training settings, and adenovirus is a well-documented pathogen found in such settings. In the 1960s, FRI outbreaks due to adenovirus were recognized as such a significant problem that a vaccine was developed to control the disease. By 1973, an oral, live virus vaccine was shown to be safe and effective. The Food and Drug Administration approved this vaccine for use in military training settings, and the military services enjoyed a great reduction in respiratory illness attack rates as a result of the vaccine's use.

A summary report of FRI surveillance in Air Force training centers from 1952 through 1987 indicates that FRI due to adenovirus was "virtually eliminated" after the 1973 initiation of adenovirus type 4 and 7 immunization (Meicklejohn & Eickhoff, 1989). Adenovirus was subsequently rarely identified, leading to the eventual decision to stop using the adenovirus vaccine among Air Force trainees in 1987. Interestingly, adenovirus outbreaks did not occur at Lackland AFB after the discontinuation of administration of the vaccine. Although rigorous virologic surveillance was not maintained continuously through the ensuing years, data obtained through isolates submitted for the Air Force's influenza surveillance program, Project Gargle, failed to show more than the occasional adenovirus isolate among Air Force populations, including trainee populations at Lackland AFB (AFIERA/SDE, unpublished data).

Commercial production of adenovirus vaccine was discontinued for economic reasons in the late 1990s, and by 1999 all vaccine supplies had been depleted. As supplies dwindled, outbreaks began to appear in Army and Navy training centers (McNeil, et. al., 1999; Gray et. al., 2000). Adenovirus illnesses were still not found in significant numbers among Air Force trainees until October 1999, when the present outbreak appears to have begun.

The Naval Health Research Center (NHRC), San Diego, California, initiated a respiratory pathogen surveillance program in October 1996 at Naval and US Marine training bases. Over the ensuing years, the program was expanded and currently covers nine bases in all four military services and the US Coast Guard. NHRC and others have documented large numbers of adenovirus cases at each of these sites in the years since the loss of the adenovirus vaccine (Gray et al., 2000). The information presented in this report is limited to the experience at Lackland AFB, TX.

PURPOSES AND OBJECTIVES

The primary purpose of this investigation was to identify potentially useful interventions that would help reduce transmission of adenoviruses. To accomplish this, the following subordinate objectives were identified:

a. maintain ongoing surveillance of FRI activity
b. establish the existence of a true outbreak through comparison with historical data
c. estimate the prevalence of adenovirus among basic trainees
d. assess the severity of illness experienced by those infected with adenovirus
e. identify personal hygiene practices among basic trainees
f. assess indoor air quality in the various training venues
g. evaluate extent of crowding in the training environment
h. assess seroconversion rates
i. evaluate risk factors for infection and hospitalization for FRI
j. estimate the economic impact
k. communicate recommended interventions to command authorities

Establishing the existence of an outbreak

Introduction: Initial indications of a potential illness outbreak at Lackland AFB came in late September 1999, when Public Health (PH) personnel at Sheppard Air Force Base noticed an apparent increase in the number of technical training students arriving from Lackland complaining of fever, nausea, and dizziness. Many of these students reported experiencing "flu-like" symptoms during the last 2 weeks of basic training at Lackland; however, fear of being recycled prevented them from seeking medical care before departure.

In accordance with their role as a sentinel site for the DoD Influenza Surveillance Program, Sheppard PH personnel submitted viral cultures to the Brooks AFB Epidemiology Surveillance Division laboratory obtained from trainees with respiratory symptoms. Specimens submitted in early October yielded positive results for adenovirus (first positive reported on 8 October 1999). By 9 November 1999, 25 out of 142 specimens were positive for adenovirus. Beginning during this same time period, the number of visits for respiratory symptoms increased in the Lackland trainee health clinics, most notably in the Warrior Week clinic. From anecdotal healthcare provider and Public Health reports, the number of FRI cases among trainees far exceeded an expected number from previous experience. In order to establish whether a changing pattern of illness was indeed occurring, an attempt was made to document FRI rates during the period preceding this apparent outbreak.

Methods: Historical data regarding ambulatory respiratory illnesses among trainees were obtained from the 59MDW Public Health Office. These reports were based on hand-kept logs and reported trend lines over time dating from January 1995. Before May 1999, clinic personnel would compile a summary tally sheet for individuals seen in clinics each day for certain diagnosis groups, and public health personnel would compile these numbers into a weekly report. Log data were available from January 1995 to November 1999. The Ambulatory Data System (ADS) began to be consistently used in the Lackland clinics in May 1999. After this date, PH relied more on ADS, rather than logbooks, to track health events in basic trainees. PH provided historical respiratory rates on two different occasions: May 1999 and April 2000. For the data from May 1999 onward, ADS records from Reid and the satellite clinics (DMIS code of 1745) with respiratory ICD-9[1] codes and a MEPRS code of BHAD (an AF recruit) were selected. To better correlate with the diagnoses captured by Public Health prior to the institution of ADS, another dataset was generated using ICD-9 codes restricted to the following: unspecified rhinitis, viral syndrome, and URI/cold. The monthly troop strength for the basic military trainees was supplied by 37 MSS/DPMX, and rates per 1000 were calculated.

To minimize the potential effect of misclassification of recruits in the ADS dataset described above, the dataset was subsequently matched to the recruit roster provided by 737 TRSS/TSOTS. Records whose social security number did not match the recruit roster were eliminated. Only the initial respiratory visit for each recruit was included.

Results: The historical data (Appendix E) show a fairly stable respiratory illness rate until October 1999. The increase in the respiratory illness rate can be seen most dramatically in the

[1] ICD-9 codes: 079.99, 382.00, 460, 461.9,462,463, 464.0, 465.0, 465.9, 466.0, 474.8, 477.9, 478.30, 486, 487.1, 493.90,

ADS records, but a slight increase can also be seen from the manual PH log data. Incidence data from the roster-matched data set for Reid and satellite clinics show similar increase in rates starting in October 1999 (Appendix F). Interestingly, there did not appear to be a distinct seasonal trend in respiratory illnesses in the historical data.

Discussion: While the respiratory illness rate increased around October 1999, the actual degree of the change was hard to characterize. Over the same time periods, there were large differences in the respiratory illness rate provided by the Public Health logbooks and the respiratory illness rate derived from the ADS records. One source of this discrepancy is the coding scheme used in ADS records. One standard ICD-9 code does not exist for febrile respiratory illness; thus, all respiratory codes had to be considered, decreasing the precision of the data. In addition, ADS does not contain a field for temperature; thus, neither historical nor ongoing FRI rates can be easily ascertained using existing data collection systems. Data collection systems were in evolution during this time period, limiting the utility of these comparisons.

ADS records reflected only outpatient visit information; visits to the Emergency Department were not included in the data. During the peak of the epidemic, many recruits were sent directly to the trainee inpatient ward. It is possible that ADS bubble-sheets were not completed for these individuals at the dispensary or clinic level, in which case those visits may not have been captured for the graph in Appendix F.

Ongoing surveillance of FRI activity

Introduction: The evaluation of ongoing illness activity requires the systematic identification of cases. At the time this investigation was started, the WHMC medical staff policy recommended hospitalization of all trainees with symptoms of respiratory illness and an oral temperature exceeding 100.4 degrees Fahrenheit. All trainees were admitted to WHMC, Lackland AFB, Texas; no other inpatient facility was used. The decision was made to use existing data systems to track trainees hospitalized for FRI, using hospitalizations as a barometer of disease activity within the trainee community. Case ascertainment was thereby simplified by using the existing clinical care network and hospitalization policy; hospitalizations were easily tracked using existing hospital data systems.

Methods: The number of trainee FRI hospitalizations to WHMC had been recorded since 24 Nov 99 using a daily hand-kept log sheet. These trainees were hospitalized under "observation" and not technically "admitted" to the hospital. The hospital's inpatient data systems were not designed to track these "observation admissions," hence the need for the hand-kept log. In late April 2000, procedures were adjusted so that each hospitalization became an official admission. The data pertaining to the admitted trainees were subsequently obtainable with considerable ease and accuracy using the hospital's existing databases. Hospital admissions were obtained from the Composite Health Care System (CHCS) through a specially designed ad hoc report on a weekly basis. To verify an individual's status as a trainee and to calculate rates, the personnel rosters for the entire basic training population were acquired weekly from the 737th Training Group. The names derived from CHCS were matched to the roster of trainees to confirm the patient's status as a basic trainee and to corroborate other demographic variables such as the individual's assigned squadron and flight, age, gender, etc. Only those inpatients

whose names appeared on the trainee roster were included in the surveillance database. Additionally, only those trainees admitted for "viral syndrome," "pneumonia," or other respiratory complaints were included in the database; admissions for other reasons such as psychiatric and surgical diagnoses were excluded. The number of basic trainees hospitalized for respiratory illnesses was compiled into a weekly report for dissemination to WHMC public health, preventive medicine, and command staff. All data files were password protected and stored on limited-access systems.

Culture results from the AFIERA/SDE Virology Lab were collected on a weekly basis and incorporated into the surveillance reports. These reports displayed the number of culture specimens received from Lackland AFB and the proportion that were positive for adenovirus or other tested agents. This proved helpful in monitoring pathogen activity among those hospitalized to ensure that adenovirus remained the primary etiologic agent as opposed to other pathogens such as influenza.

Results: Hospitalization numbers peaked in April and May 2000, with rates reaching a high of 26/1000 recruits/week during the last full week of May (see Appendix C). The number of admissions averaged 7.3 per day, with a maximum of 24 and a minimum of 1. The proportion of specimens from which adenovirus was recovered remained generally consistent at approximately 60% throughout the period of the investigation. Specimens from 3 individuals yielded herpes simplex viruses, but no other pathogens were isolated during the period of surveillance.

Discussion: The major limitation resulting from the decision to use hospitalizations for the surveillance data source was the possibility of incomplete capture of cases. To be captured as a "case," not only did the trainee have to make the decision to seek medical attention, but his/her signs and symptoms also had to be severe enough to meet a threshold, and the clinic staff had to make the determination that the individual was to be hospitalized. No attempt was made to assess the occurrence of non-hospitalized cases or to track rates of illness among trainees not seeking medical care. This resulted in an uncertain degree of underestimation in the number of cases.

The data depicted in Appendix C show the large numbers of ill trainees at Lackland AFB during this time period, which in turn reflect the burden borne by WHMC in caring for these patients.

An interesting pattern emerged, best visualized in the graph in Appendix D. A 3-5 week periodicity in hospitalization rate peaks is easily observed. The reason for this pattern remains speculative. The most likely explanation is the occurrence of overlapping mini-epidemics. Perhaps if the population did not receive weekly infusions of unexposed people, the outbreak would burn itself out within a few weeks. However, each week brings a new group of susceptible individuals. Perhaps the proportion of susceptibles in the population increases until some critical level is reached, allowing repeated "mini-epidemics" to recur. It is expected that this pattern will continue until effective interventions are implemented.

The difficulty in determining an historical baseline rate for respiratory illness highlights the need for a more accurate and standardized ongoing surveillance system for this population.

Adenovirus carriage prevalence estimation

Introduction: Faced with a perpetuating outbreak of FRI among trainees, an attempt was made to ascertain the extent of adenovirus carriage among non-hospitalized trainees. The training environment is conducive to efficient transmission of droplet-spread respiratory pathogens, and the prevalence of pathogen carriage was felt to have an impact on our assessment of the likelihood of successful interventional control of the outbreak. Other than serologic prevalence studies, no published studies of the prevalence of adenovirus among non-hospitalized training populations could be found.

The specimens for this study were collected from trainees as they marched into the equipment issue tent for Warrior Week. Warrior Week occurs during the fifth week of training and consists of training in a field environment from Sunday through Friday. The trainees march a short distance to the training site and are issued field training gear such as sleeping bags and gas masks. Trainees sleep in tents, undergo training in both tents and outdoors, and perform their 5-mile march during this week. While there is no formal medical screening at the beginning of this week, trainees starting Warrior Week are considered generally healthy.

Methods: Three hundred eighty-six trainees entering Warrior Week on 7 May 00 were asked to voluntarily participate; all volunteered. Trainees were asked if they were presently experiencing a fever, sore throat, and/or cough. Providers conducted a cursory examination of the oropharynx, nose, and conjunctivae as the cultures were being taken to evaluate the presence of current respiratory infections. The current presence of symptoms by history and by exam was recorded for each trainee.

The hospitalization experience of this cohort was examined using the roster of hospitalized trainees collected as part of the overall investigation.

Results: Seventeen percent (64/386) of the trainees were culture positive for adenovirus. Neither self-reported nor provider-observed symptomatology was associated with having a positive adenovirus culture [OR=1.33 (95% C.I. 0.78, 2.27); 1.07 (0.60, 1.89) respectively]. Recruits in the 323rd, 324th, and 331st Training Squadrons were less likely than recruits in the 320th Training Squadron to have a positive culture for adenovirus [0.17 (0.07, 0.40); 0.38 (0.19, 0.74); 0.19 (0.08, 0.46) respectively]. No significant difference was noted between the two flights in squadron 320 attending Warrior Week [0.51 (0.22, 1.17)]. Incidentally, 14% (53/386) of this cohort had been or would be hospitalized during their basic training. Thirty-three (62% of those hospitalized) were hospitalized prior to the study and twenty (38%) were hospitalized following the study. Of the trainees who experienced a FRI hospitalization at any time during basic training after the study, 85 % (17/20) had previously had a negative adenovirus culture on 7 May 2000.

Table 1. Adenovirus Carriage Prevalence Data Summary

	Positive Culture	Negative Culture	Crude OR	95% CI
Reported Symptoms				
No	33	188	Ref	Ref
Yes	31	133	1.33	0.78-2.27
Observed Symptoms				
No	43	218	Ref	Ref
Yes	21	100	1.07	0.60-1.89
Squadron 320	34	71	Ref	Ref
Squadron 323	7	86	0.17	0.07-0.40
Squadron 324	16	88	0.38	0.19-0.74
Squadron 331	7	77	0.19	0.08-0.46
Squadron 320				
Flight 323	21	32	Ref	Ref
Flight 324	13	39	0.51	0.20-1.27

Discussion: A prevalence of 17% among ambulatory trainees in the midst of regular training activities is considered high. With such a pervasive presence of the pathogen, the likelihood of successfully interrupting disease transmission with environmental or behavioral interventions is fairly low. However, data are not available regarding the contagiousness of an individual who carries adenovirus in his or her oropharynx, hence one should not technically label these 17% as "carriers." Further study is needed to determine the likelihood of transmission in both symptomatic (coughing, sneezing) and asymptomatic persons with culturable adenovirus present in their upper respiratory pathways.

The finding of a markedly different adenovirus carriage prevalence in the 320th Training Squadron is interesting but remains unexplained.

Severity of the clinical syndrome

Introduction: In military populations, symptomatic adenoviral infection is typically characterized by the following: fever, malaise, nasal congestion, sore throat, hoarseness, headache, and cough (Gaydos & Gaydos, 1995). In a study of Army trainees at Fort Jackson in 1998, it was found that over 90% of recruits admitted to the Acute Respiratory Disease (ARD) Infirmary experienced fever, chills, sore throat and persistent cough (Kolavic et al., 1998). The mean length of stay in the infirmary was 2.2 days. Similar symptoms were reported during an

adenovirus outbreak at an Army basic training installation in November/December 1997. During this time frame, the average in-hospital length of stay was 2.8 days (Sanchez et al., 1999).

A review of inpatient medical records was conducted to characterize the clinical spectrum of febrile respiratory illness among trainees admitted to WHMC and to elucidate the natural history of the outbreak. During the period of this medical record review, the policy of the local medical staff was to hospitalize all trainees with oral temperatures exceeding 100.4° F. Each trainee's oral temperature was assessed every four hours, and discharge from the hospital was withheld until the trainee was afebrile for 12 straight hours without the use of antipyretic medications.

Methods: The list of patients hospitalized from 24 November 1999 through 30 April 2000 was given to the medical records office at WHMC. Batches of 10 – 20 records were pulled daily by the medical records office. A convenience sample of 352 inpatient medical records was ultimately examined; the sample was temporally representative of the time period during which recruits had been hospitalized. No systematic selection process was used other than to try to ensure that the records reviewed represented the temporal distribution of the time period during which trainees were being hospitalized for FRI. Although this was a convenience sample and the records were not randomly selected, the charts were considered representative in respect to admission date, training squadron, and other demographics.

A MS Access database was created by AFIERA/RSRH to capture data of interest from the medical records in a systematic manner. Personnel from AFIERA/RSRH reviewed the medical records at WHMC and entered relevant information into the computer program. The entire data set was analyzed in aggregate.

Results: In 78.1% of records, "viral syndrome" was listed as the primary diagnosis. A sore throat or cough (or both) was recorded for 97% of the 352 abstracted charts, and 31% had some note of dehydration. Of the 233 records reviewed for radiographic examination of the chest, 28 had a chest radiograph recorded, and 7 (25%) of these showed evidence of pulmonary pathology. The median and the mean for the maximum temperature recorded in the inpatient record was 102.3° F. Sore throat was the predominant symptom, followed by cough and headache (Table 2). The mean number of symptom days before admission was 3.5 days.

Table 2. Frequencies of symptoms recorded.

Symptom	Number	Frequency
Sore Throat	305	86.6 %
Cough	260	73.9 %
Headache	240	68.2 %
Chills	228	64.8 %
Myalgia	197	56.0 %
Malaise	184	52.3 %
Rhinnorhea	181	51.4 %
Nausea	112	31.8 %
Arthralgia	69	19.6 %
Vomiting	59	16.8 %
Conjunctivitis	28	8.0 %

Discussion: This review of inpatient medical records reinforced the clinical impression that trainees admitted for FRI experienced substantial morbidity and not simply "regular colds". The record review also reinforced the notion that nearly all hospitalizations of trainees to this ward were for FRI as opposed to other conditions; hence the large excess of trainee hospitalizations in general was attributable to respiratory illness.

This study demonstrated that FRI is a burden on both the individual recruit and the available medical resources. The average length of hospitalization was slightly longer for recruits admitted to WHMC than for trainees in studies done on Army training installations. The clinical picture of this adenovirus outbreak is otherwise similar to the results provided by other FRI studies in recruit settings.

Personal hygiene practices among trainees

Introduction: Personal hygiene may be compromised in the military training setting due to factors such as the rigid training environment and trainee social culture. Although the role of personal hygiene in the spread of adenovirus types 4 and 7 has not yet been determined, poor hygiene has been associated with the spread of other infectious respiratory agents. Adenovirus types 4 and 7 are primarily spread through the air although contaminated fomites and direct contact may also play a role. Enteric adenoviruses have been shown to persist on environmental surfaces for prolonged periods of time, and transmission of adenovirus-associated epidemic kertaoconjunctivitis through handshaking has been described in the literature (Abad, 1994; Azar, 1996; Couch, 1966). We examined self-reported hygiene behavior in the context of this outbreak to evaluate potential transmission risk factors and to identify public health intervention opportunities.

Methods: An anonymous, self-completed questionnaire was administered to 493 individuals. Questionnaires were administered to 57 hospitalized trainees, 413 trainees during Warrior Week and 23 Military Trainee Instructors during May 2000 (the questionnaires are reproduced at Appendix G1-G4). Topics covered in the questionnaire included behavior related to: handwashing, tissue use, sharing of personal items such as canteens and toothbrushes, bathing and self-perceived stress. Respondents were also asked about clinical symptoms associated with a cold or flu-like illness, timing of clinical symptoms, hospital admission due to cold or flu-like illness and the timing of hospital admission. Each questionnaire included a bubble-sheet question section and an open-ended question section. The completed bubble-sheets were scanned into the computer, formatted as an ASCII file, and imported into a Microsoft Access database. A coding scheme for the open-ended portion of the questionnaire was developed and validated by several members of the study team (see Appendix H). Any responses that were not readily classifiable were discussed and coded by consensus. Responses were entered into a Microsoft Access database. This database was converted to an SPSS (v. 9) file for statistical analysis.

Results: A total of 470 trainees completed the risk factor questionnaire. There was a statistically significant difference in reported hand-washing frequency by squadron. Seventy-six percent of

the trainee respondents said that their use of sinks was self-limited in order to avoid having to clean them. Report of having respiratory symptoms during training was significantly associated with the following:

male gender: OR 1.33 (1.10, 1.59)
wash hands rarely/never after sneezing: OR 1.4 (1.1, 1.7)
wash hands rarely/never after coughing: OR 1.7 (1.3, 2.3)
high perceived level of stress: OR 1.3 (1.1, 1.5)

Anecdotal comments written by trainees included a number of comments regarding personal hygiene practices. The responses are summarized in appendix O and point to a number of potential improvements in hygiene practices, such as improved access to hand washing facilities, increasing the distance between personnel in formations, and allowing the use of facial tissues. The survey supported direct observations that many trainees purchased waterless hand sanitizers (e.g. Purell brand) and that the trainees relied on these products for hand sanitation. The truth of some of the comments (such as using toilet water to wash hands) could not be verified.

Anecdotal comments written by MTIs included suggestions to relax the strict latrine inspection standards, to better separate ill trainees and instructors from those who are well, and improved briefings on hygiene (appendix P).

Discussion: Analysis of the questionnaire identified infrequent handwashing as a potential hygiene problem that is associated with respiratory symptoms in this setting. Anecdotal information from the trainees and instructors underscored this finding. Comments from trainees such as, "We're given 5 minutes to use the latrine, and there are 50 of us," were common. Furthermore, there are self- or culture-imposed restrictions on facilities. Trainees who are given oversight responsibility for latrine cleaning ("latrine queens") may limit the use of sinks to two of the seven sinks available in the barracks in order to reduce cleaning time. Although adenovirus types 4 and 7 are spread most efficiently through the air, unpublished information from the Naval Recruit Training Center indicates that increased frequency of handwashing decreased the incidence of respiratory infections (Ryan, M. CDR, personal communication, May 11, 2000). While handwashing alone is not expected to dramatically curtail adenovirus illness transmission, improved handwashing practices may help reduce adenovirus and other respiratory pathogen transmission when coupled with other interventions. Moreover, it is an important life-long habit that has demonstrated efficacy in the avoidance of other infectious diseases and should be reinforced in military basic training. Another finding was that many trainees purchase an alcohol-based self-drying hand cleaner for personal use. While the use of this product used in conjunction with handwashing may be beneficial in certain circumstances, it should not replace handwashing. The frequency, pervasiveness, or effectiveness of its use in this setting is unknown. The efficacy of alcohol-based hand cleaners in preventing adenovirus transmission is also unknown.

Questionnaire responses indicated that rules concerning disposable tissues might be an obstacle to trainee tissue use. Trainees must keep all personal items, including disposable tissues, within their own portfolio or locker. Depending on the setting, a trainee may be required to ask for permission before using a tissue. Not only is this logistically difficult (one may not have enough

time to ask before coughing or sneezing), it also requires a trainee to bring personal attention to him or herself. As a result, these rules may discourage trainees from using a tissue when they sneeze or cough, potentially leading to enhanced pathogen dispersal.

Indoor air quality assessment

Introduction: Adenovirus is one of many respiratory pathogens transmitted by droplet spread. Inadequate fresh air circulation may indicate ideal environmental conditions for airborne disease transmission due to an increased local concentration of the pathogen. Because of the airborne nature of the threat, an investigation of the quality of indoor air in selected training environments was undertaken.

Trainees spend most of their time in defined areas, including the dormitory or sleeping area, classroom, and outdoors. Generally, very little time is spent inside the dining facilities, chapels, or other office spaces such as medical clinics or supervisory offices. We estimated that the two venues most likely to contribute a possible health risk due to indoor air quality (IAQ) issues were the sleeping areas and the classroom. The typical trainee spends approximately 35-40% of his/her time in the dormitories (including personal hygiene and cleaning time). About 15 hours per week are spent in the classroom beginning the third week; much less classroom time occurs earlier in training because of a heavier emphasis on drills and physical training during the first two weeks. Because of these considerations and resource limitations, measurements were made only in selected sleeping areas and classrooms.

IAQ can be assessed in a number of ways, but perhaps the most simple and understandable is the measurement of environmental (or ambient) CO_2 concentrations. As a product of respiration, CO_2 is used as a surrogate for "freshness" of indoor air. Higher CO_2 concentrations indicate inadequate outside air circulation, and elevated levels have been associated with adverse health effects, including eye irritation, headache, drowsiness, and difficulty concentrating (Rajhans, 1983, as cited in Bright, Mader, Carpenter, & Hermon-Cruz, 1992). One device that measures CO_2, temperature, and relative humidity simultaneously was available for use during the study period.

The American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE), the US Environmental Protection Agency (EPA), and the National Institute of Occupational Safety and Health (NIOSH) have all proposed parameters used in judging the quality of indoor air. Space does not permit a full explanation of the complex issues involved in assessing IAQ and establishing IAQ standards for the workplace or living spaces (see Bright et al., 1992, for a brief discussion of these issues). For simplicity, we used the ASHRAE standard of a CO_2 concentration of 1000 parts per million as an indicator of poor IAQ.

The buildings used to house and instruct the trainees are known as Recruit Housing and Training Buildings (RH&Ts). All six RH&Ts in use at the time of these studies were essentially identical in layout. They each contain classrooms (labeled A-H), a dining facility, sleeping areas ("bays" labeled A-1 through A-10 on the second floor and B-1 through B-10 on the third floor), and squadron administrative offices. Each bay has its own air-handling unit with adjustable fresh air intakes, which for economic reasons are set more widely open during fair weather. According to

base Civil Engineering personnel, the air temperature in the classrooms is controlled by forcing ambient air over heating or cooling coils; however, the design does not allow for fresh incoming air other than the circulation achieved when the doors are open.

Methods: IAQ was ascertained by simultaneous measurement of CO_2, temperature, and relative humidity. A TSI model 8550 CO_2 monitor was used for taking measurements in four classrooms and four dormitory sleeping areas. The rooms were selected because of their location in two squadrons with the highest and lowest incidence of FRI hospitalizations. Measurements were obtained over an 8 to 24 hour period in the classrooms and over an approximately 48-hour period in the dormitory sleeping areas.

Results: Three of the four dormitory sleeping areas remained below 1000 ppm through the night. The one sleeping area that exceeded 1000 ppm CO_2 peaked briefly at a maximum of 1654 ppm. The classroom levels of CO_2 all remained below 1000 ppm while not in use, but exceeded the recommended CO_2 level while it was in use, with one classroom peaking above 5000 ppm. Table 3 summarizes the results. Opening of the classroom doors while in use somewhat decreased the classroom CO_2 level, but the level still exceeded the ASHRAE recommendations. Two sample tracings, one from a classroom and one from a dormitory, are included at appendix M and N.

Table 3. Summary of IAQ data from the eight rooms tested.

Room		Building	>1000 ppm CO_2 during the recording period
Classrooms	A	9210	Y
	C	"	Y
	B	9310	Y
	E	"	Y
Sleeping Areas	A5	9210	Y
	B4	"	N
	A5	9310	N
	B6	"	N

NOTE: Building 9210 houses the 322nd Training Squadron which had the lowest overall hospitalization incidence during the study period; building 9310 housed the 320th Training Squadron which had the highest hospitalization incidence.

Discussion: Occupied classrooms usually approach their maximum capacity, with the desks touching side-by-side and minimal legroom between rows. Anecdotal reports from the students and instructors indicate that "stale" indoor air of poor quality in the classrooms is common. By the ASHRAE standard, the results document that the quality of indoor air in the classrooms is indeed poor, a finding not surprising given the apparent air handling design for those rooms. Whether this finding is of significance in the transmission of droplet-spread pathogens is another question. However, even for purposes of providing an optimum learning environment, one

would expect that the indoor air of the classrooms would be improved, and one could expect that the concentration of not only CO_2 but also airborne pathogens would be decreased by the introduction of fresh outside air into the closed indoor environment.

Although only a small number of rooms were tested, the findings indicate a more significant air quality problem in the classrooms as opposed to the sleeping areas. The air handling design in the sleeping areas allows variable proportions of incoming fresh air to mix with recycled air; not so in the classrooms. In addition, the occupancy concentration is higher in the classrooms, resulting in a more rapid buildup of CO_2. The contribution of poor IAQ to transmission of adenovirus remains unresolved.

Extent of crowding in the training environment

Introduction: Because the FRI outbreak appeared to be limited to recruits, and crowded conditions is a hallmark of recruit training, an attempt was made to assess the extent of crowding in the training environment. The trainees generally spend the most indoor time in the sleeping areas (dormitories) and classrooms. The dining facility was not considered an area at high risk for respiratory pathogen spread because the trainees spend only about 10 minutes there, 3 times each day. Training areas out of doors were similarly not considered high-risk areas for respiratory pathogen spread. During the 5th week of training, recruits sleep and are instructed in temper-tents.

The extent of crowding is dependent upon the number of recruits. This number fluctuates seasonally due to global recruiting factors, such as the state of the economy, varying induction incentives, and other macro-level factors not under the control of local officials. The weekly total number of recruits in training increased from approximately 4,000 in November 1999 to just under 6,000 in May (Figure 1). During this time, the increasing numbers of recruits necessitated the filling of training flights and their dormitories to capacity.

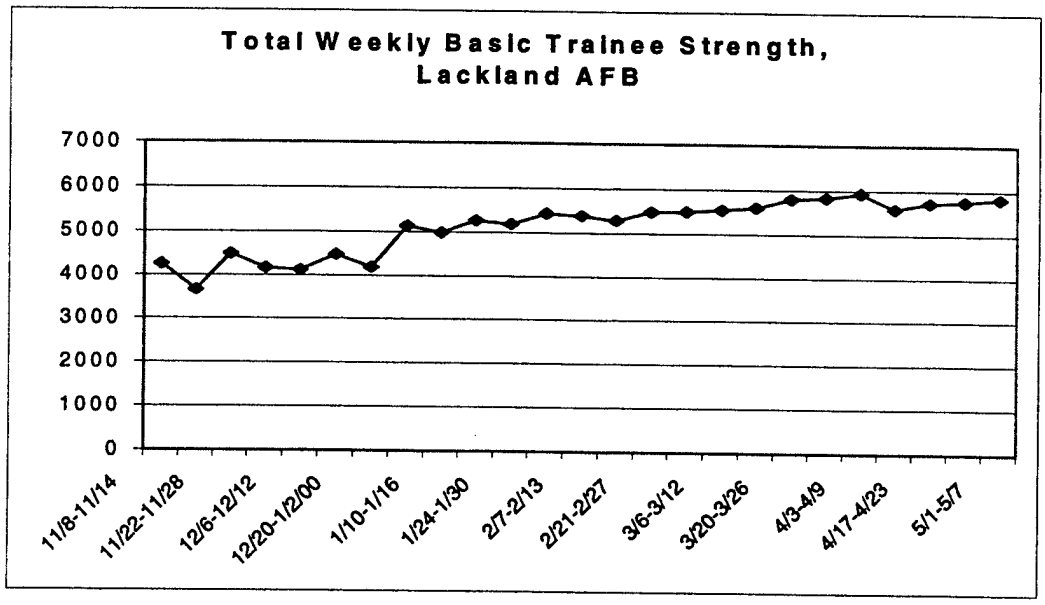

Figure 1. Increase of weekly total number of recruits.

The RH&Ts have five classrooms, all with slightly different sizes. Most have accordion-type doors that can be easily opened or closed. Trainees undergo 2-3 hours of classroom instruction during each of the first 2 weeks, but in the third and fourth weeks that number increases to approximately 15 hours per week.

Methods: Building plans were used to calculate the living space in the dormitories and classrooms. The number of trainees in each flight was determined by averaging a sample of actual flight rosters. Naturally the number of trainees in the flights varies; these are only estimates.

Results: The dormitory bays contain 3,859 square feet of living space. A cross sectional sample in May 2000 showed 29 flights with a total recruit population of 1449, or 50 trainees per flight with a range of 41 to 56. Dividing the available living space by 50 (the average number of trainees per flight during this time) gives a result of 77.18 ft^2 per trainee for a training flight of average size. Figure 2 shows how the living space available per person varies as the flight population changes.

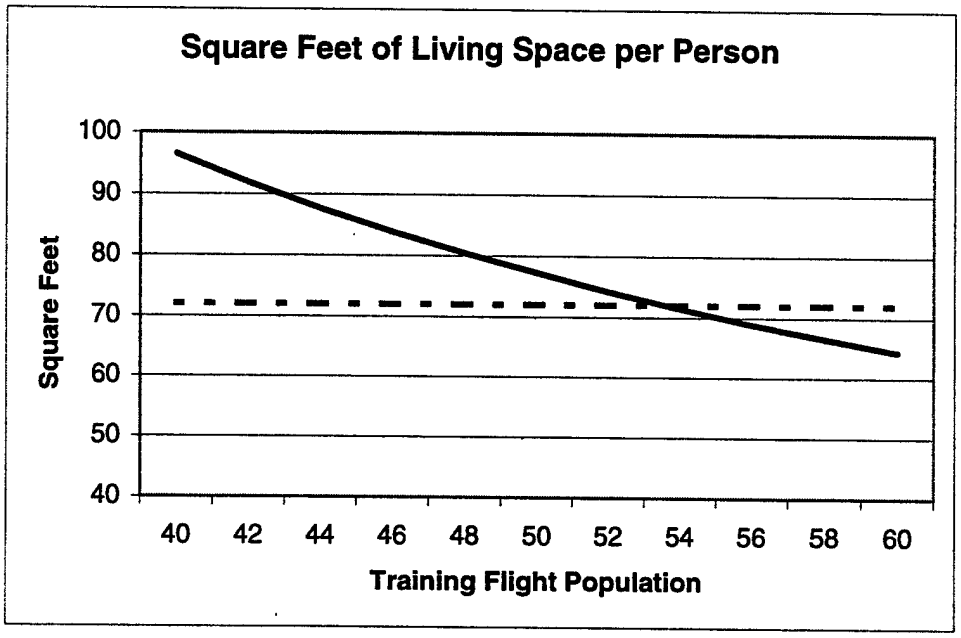

Figure 2. Living space available per person.
(Note: the DoD net living space standard for trainee dormitories is 72 square feet, marked with a dashed line in this figure).

The typical classroom has about 1107 square feet and is used to train one or two flights at a time. If an average flight has 50 personnel, there would be 100 trainees in a classroom. Including two instructors per classroom and the calculated per-person floorspace is 10.6 square feet.

Discussion: The number of trainees per flight is dependent on a number of factors, including incoming recruit populations, number of instructor cadre, and building availability. These and other factors are largely beyond the control of Lackland AFB officials.

The standard living space allowance for E-1 recruits is "72 square feet net living area open bay; central bath" (DoD 4165.63M; DoD Housing Management). The derivation of this standard is not clear, but may in part date back to studies conducted in barracks during World War I. Those studies documented rates of respiratory infections that increased in parallel with increased crowding. No attempt was made during this investigation to associate attack rates with flight-specific dormitory crowding.

To meet the standard of 72 square feet per person, training flights should not be manned at greater than 54 trainees per flight.

We could find no standards for square foot allowances for classroom settings.

Seroconversion

Introduction: Attack rates of acute respiratory disease during adenovirus-associated outbreaks have affected up to 80 percent of new recruits within the first three weeks of training. Of these, up to 20 percent may require hospitalization (Gaydos & Gaydos, 1995; Rubin, 1993). McNeill, et al., (1999) demonstrated that 66 percent of all acute respiratory illness in US Army recruits at Fort Jackson during an outbreak was due to adenovirus type 4. Early studies quantified the infection and clinical illness rates (from 35 – 76 percent) by direct inoculation of the eyes, oropharynx and nasopharynx of institutionalized volunteers (Bell et al., 1956). This study, as well as subsequent observational studies, revealed that those possessing higher initial adenovirus neutralizing antibody titers were less susceptible to infection than those with low or no evidence of neutralizing antibodies (Bell, et al., 1956; Sanchez, et al., unpublished; & Kolavic et al., 1998). Prevalence estimates, which have been established in US Army studies, reveal that as many as 90 percent of hospitalized trainees (Sanchez, et al., unpublished) and 49 percent of non-hospitalized trainees (Kolavic, et al., 1998) had at least a four-fold adenovirus antibody seroconversion, usually in weeks five to seven of training.

No studies to date have been done to examine the seroconversion rate in USAF basic trainees. The purpose of this study was to discover the proportion of Air Force recruits who entered basic training without evidence of recent exposure to/infection with adenovirus and subsequently left basic training with evidence of exposure to/infection with adenovirus.

Methods: One hundred twenty-six individuals from Lackland AFB, Keesler AFB and Sheppard AFB participated in an adenovirus seroconversion study between June and August 2000. Blood samples are routinely taken from all BMTs during their first week of basic training at Lackland AFB as dictated by official protocols. For this study, aliquots of the 528 samples drawn 24 Apr 00 were separated and frozen for future analysis; the specimens were saved at the Epidemiological Surveillance Division of AFIERA (AFIERA/SDE). Following graduation from basic training, individuals whose sera were saved and were known to be attending technical training at one of the three bases mentioned above were identified. AFIERA/RSRH contacted the technical school training commanders and the public health officers and laboratory officers at the three bases, asking for their support in the study. All three bases agreed to participate.

The identified technical students were asked to volunteer for the study. Those who agreed signed a consent form and a new blood sample was drawn. The serum was separated then sent to AFIERA/SDE; sera were frozen for shipment from the distant sites. Blood was drawn on the Lackland volunteers on 27 and 28 June 00. Sheppard and Keesler student blood samples were drawn 30 June – 7 August 2000.

The Immunology branch of AFIERA/SDE performed complement fixation tests for detection of adenovirus antibody on the paired samples. Complement fixation testing antigen includes serotypes 3, 4, 6, and 7. A four-fold rise in titers from the pre-training to post-training sample was defined as indicative of exposure to or infection with adenovirus in the interval between which the labs were drawn. A rising titer could not be considered specific for adenovirus type 4, which was the type responsible for the outbreak at Lackland AFB.

Hospitalization records were reviewed for comparison to individuals' seroconversion status.

Results: Thirty-nine percent (49/126) of the samples clearly had a 4-fold increase in titers, indicating a positive test. Fifty-six percent (71/126) of the samples clearly did not have a 4-fold increase in titers, indicating a negative test. Five percent (6/126) had a possible 4-fold increase in titers, suggesting a positive test. These six nebulous records were excluded from analysis since serology tests could not clearly identify them as positive or negative.

Sixteen percent (8/49) of recruits with a positive serology test had been admitted to the hospital for a respiratory illness. All had had respiratory cultures taken on admission: 6 (75%) were positive for adenovirus and 2 (25%) were negative for adenovirus, influenza, parainfluenza, enterovirus, HSV, and RSV. Eight percent (6/71) of recruits with a negative serology test had been admitted to the hospital for a respiratory illness. All had had respiratory cultures taken; 4 (66%) were positive for adenovirus and 2 were negative for adenovirus, influenza, parainfluenza, enterovirus, HSV, and RSV. Recruits with a positive serology result were no more likely than recruits with a negative serology result to be admitted to the hospital for a respiratory illness [OR=2.11 (0.59, 7.92)].

Fifty-seven percent (28/49) of the recruits with a positive serology test sought care (had an Ambulatory Data System (ADS) record for a respiratory complaint excluding asthma) during recruit training (n=23) or tech school (n=5). No electronic record of a respiratory health event during basic training existed for forty-three percent (21/49) of the recruits with a positive serology test.

Fifty-one percent (36/71) of the recruits with a negative serology test sought care (had a record in ADS for a respiratory complaint) during recruit training (n=32) or tech school (n=4). Recruits with a positive serology result were no more likely than recruits with a negative serology result to seek care for a respiratory illness complaint [OR=1.30 (0.62, 2.70)].

Seventy-six percent (37/49) of recruits with a positive serology test were male and 24% (12/49) were female, similar to the distribution of males and females in the recruit population (p=0.76). Seventy-three percent (36/49) of recruits with a positive test were 17-20 years of age and 27% (13/49) were 21 years or older, similar to the distribution in the recruit population (p=0.71). Recruits 17-20 years old were approximately twice as likely to have a positive serology test than recruits 21 years or older when controlling for gender [OR=2.16 (0.98-4.75)]. However, this finding was not statistically significant, probably due to the small sample size and subsequent lack of power to detect a true difference.

Female recruits with a positive serology result were more likely to have a visit for a respiratory complaint (ADS record) than female recruits with a negative serology result when controlling for age [8.33 (1.34,51.66)]. Male recruits were not more likely than female recruits to be hospitalized or to have a visit for a medical respiratory complaint (ADS record) [OR = 0.513 (0.11, 2.44) and OR = 1.22 (0.52, 2.87), respectively].

Discussion: Thirty-nine percent of the trainees in the present study showed evidence of exposure to or infection with adenovirus after arriving at basic training. Due to logistical difficulties in

obtaining the convalescent specimens, this attempt at defining seroconversion during basic training was limited by the prolonged lag time in resampling the trainees. Therefore, it is possible that some individuals who developed an antibody reaction to adenovirus may have done so through post-basic training exposure. Further studies should be undertaken which resample BMT's blood for evidence of exposure to/infection with adenovirus before the BMT's leave basic training.

Female recruits with a positive seroconversion test were more likely to have had a medical visit for a respiratory complaint than females with a negative test. This association was not true for male recruits, however. Also male recruits regardless of seroconversion status were not more likely than female recruits to be hospitalized or to have a visit for a medical respiratory complaint. This is consistent with another study that showed no difference in admission rates by gender (McNeill et al., 1999).

Lastly, a large percentage (43%) of those with a positive serology did not seek medical care. This implies that many infected individuals may be asymptomatic or do not seek care. It is unclear whether asymptomatic individuals are capable of transmitting adenovirus to surrounding trainees.

Risk factors for hospitalization and adenovirus infection

Introduction: We attempted to use existing data to evaluate the role of clinic and Emergency Department (ED) waiting room settings in the transmission of febrile respiratory illness among trainees at Lackland AFB and to examine the influence of prior clinic or ED respiratory visits on subsequent inpatient admission.

Methods: This study focused on recruits whose entire 6 weeks of Air Force basic training occurred between February 6, 2000 and May 15, 2000. This period was chosen because the inpatient admission criteria remained consistent during this time and data on these cohorts' healthcare experiences during this entire time period were available. Admission criteria during this time period included an oral temperature of at least 100.5 °F and a cough or sore throat. Admission criteria were adjusted to allow for provider's discretion at the end of May 2000. Demographic, clinical, and any virology data were gathered for all recruits who arrived for basic military training between February 7 and March 27, 2000 and who graduated by May 15, 2000. 737 TRSS/TSOTS provided demographic data, including name, social security number, date of birth, squadron, flight, arrival date, and graduation date. Clinical data were gathered from CHCS and SADR. CHCS provided name, social security number, admission date, admission diagnosis, and squadron of hospitalized recruits. SADR was used to find medical records for Reid Clinic, for satellite clinics B and C, and for the ED. Outpatient ADS records were filtered for trainees using the MEPRS code of BHAD and, for Reid and the satellite clinics, using the DMIS code of 1745. Emergency Department visits were filtered for trainees using the MEPRS codes of BIAA or BIAB. The ICD-9 code for primary diagnosis was used to categorize visits into broad DNBI (Disease Non Battle Injury) categories (see Appendix I). Medical records were then matched by social security number to the demographic data in order to verify recruit status. Only those visits belonging to a trainee and occurring between February 6 and May 15, 2000 were kept for analysis. The Brooks AFB Virology Lab provided the results of adenovirus cultures.

Data were stored in a password-protected SPSS v10.0 database. Several new variables were created based on the clinic and ED visit information. First, the total number of clinic/ED visits during basic training was calculated and categorized. Next, the number of nonrespiratory visits during basic training was computed. Four percent of the records were missing primary ICD-9 codes and were removed from the analysis because visit type (respiratory vs. nonrespiratory) could not be determined for these records. These records were excluded from the computation of all subsequent variables as well. For those recruits admitted to the hospital, the number of non-respiratory visits prior to admission date was counted. In addition, total visits minus any respiratory visits within 4 days of hospitalization were calculated. Last, the number of respiratory visits, excluding those within 4 days of admission, was calculated for hospitalized recruits. These variables were then dichotomized. EpiInfo 6.0 was used to calculate crude odds ratios and to stratify by covariables (age, gender, and squadron) to evaluate confounding and interaction. Binary logistic regression was preformed in SPSS 10.0, using hospitalization as the outcome variable. Respiratory visits within 4 days of hospitalization were excluded from visit counts because these visits were most likely associated with the illness that caused the individual to be admitted.

Results: Data from 4,688 recruits were analyzed. Of the 4,187 (89.3%) recruits who had at least 1 clinic or ED visit, 354 had been hospitalized (non-psychiatric and non-surgical reasons), and 241 had a positive adenovirus culture. When examining crude relationships, several statistically significant associations were noted (see Appendix J). Individuals in Squadron 320 were more likely to be hospitalized (OR = 1.66, 95% CI: 1.23 - 2.14) and more likely to have a clinic visit (OR=2.44, CI: 1.92 - 3.06) compared to individuals in other squadrons. Trainees in Squadron 322 were less likely to be hospitalized (OR=0.63, CI: 0.46, 0.87) compared to trainees in other squadrons. Trainees who were 23 years or older were also less likely to be hospitalized compared to trainees 22 years or younger (OR=0.69, CI: 0.51, 0.91), as were females compared to males (OR=0.61, CI: 0.51, 0.93). Clinic visits also influenced hospitalization. Recruits with one or more clinic visit (of any kind) were much more likely to be admitted compared to trainees who did not have any clinic visits (OR=32.08, CI: 10.28, 100.14). However, having had only nonrespiratory visits (prior to hospitalization among those who were admitted) appeared to be protective against hospitalization compared to not having had a nonrespiratory visit (OR=0.80, CI: 0.64, 1.0).

In order to clarify the influence of clinic visits on hospitalization, binary logistic regression was performed, controlling for age and gender (see Appendix K). Because interaction between Squadron 320 and number of clinic visits was statistically significant ($p<0.001$), further analyses were stratified by squadron. After visits within 4 days of admission were excluded, having had one or more clinic visits (prior to hospitalization among those who were admitted) was not significantly associated with hospitalization in any squadron. In fact, it appeared to be protective in Squadron 320 (OR= 0.32, CI: 0.19, 0.52). The age-admission and gender-admission associations were no longer statistically significant, except in Squadron 321 where being female remained inversely associated with admission (OR=0.33, CI: 0.15, 0.71) (not shown in table).

The relationship between hospitalization and having had a prior clinic or ED visit for a respiratory illness was also examined. After stratifying by squadron and controlling for gender

and age, having had one or more respiratory visits was significantly inversely associated with hospitalization in Squadrons 320 (OR= 0.61, CI: 0.38, 0.97), 322 (OR=0.49, CI: 0.24, 1.01), 323 (OR= 0.50, CI: 0.25, 0.99) and 324 (OR=0.37, CI: 0.19, 0.73). Again, being female in Squadron 321 appeared to reduce the chance of being admitted when controlling for age and having had a prior respiratory visit.

Discussion: The strong association between having had at least one clinic or ED visit (of any type) and hospitalization was not surprising, since mandatory post-discharge visits (among those who were hospitalized) were included in this crude analysis. The inverse relationship between hospitalization and having had at least one non-respiratory illness or injury prior to that hospitalization (post-hospitalization visits and visits within 4 days of hospitalization were excluded for those who were hospitalized), however, remains unexplained.

Preliminary analyses indicated potential differences in disease burden and health care-seeking behavior by squadron. After exclusion of respiratory visits within 4 days of admission, 86% of recruits from Squadron 320 had either a clinic or an ED visit compared to 76% of recruits in all other squadrons. Trainees from Squadron 320 were also significantly more likely to be hospitalized compared to trainees from other squadrons. Trainees are randomly separated into squadrons upon arrival to basic training, and then they are randomly assigned to a flight within that squadron. The flights are comprised of 30-60 individuals who share sleeping, eating, and hygiene facilities. Every flight has a sister or brother flight, and the two flights train together for the duration of basic training under the supervision of a team of military training instructors (MTIs). There is little interaction between members of different squadrons until their fifth week of training. Prior to the fifth week of training when the recruits "deploy" to Warrior Week, mingling between squadrons is limited to church attendance or chance encounters such as the clinic setting or weekend entertainment.

A number of potential reasons for squadron-dependent admission rates follow:

- Access to its designated satellite clinic. Access may differ between squadrons because satellite clinic C is located in the same building as Squadron 320; Squadrons 321 and 322 are also assigned to satellite clinic C but are located in adjacent buildings that are only about 150 meters away. Whether access actually varies, and whether it varies because of this small difference in clinic proximity, is unknown.
- Potentially differential treatment by clinic providers. Since the same providers attend to trainees from Squadron 321 and 322, this is not a likely explanation for the difference observed only in Squadron 320.
- Trainee care-seeking behavior. It is possible that recruits from Squadron 320 were more likely to seek medical attention for illnesses and injuries compared to recruits in the other squadrons. We were not able to explore individual patterns of health care-seeking behavior.
- Command-related care-seeking behavior. MTIs assigned to Squadron 320 during that particular time period may have been more encouraging of trainees seeking medical attention compared to the MTIs of other squadrons. We were not able to explore squadron-specific command-related policies or practices regarding health care-seeking behavior.
- Actual illness differences. It is possible that the trainees in Squadron 320 were more ill compared to trainees in the other squadrons. While the design of the dorms and

classrooms are identical, physical environments may vary by squadron. For example, perhaps the air handling system in the Squadron 320 dorms are less efficient and Squadron 320 trainees were exposed to a higher proportion of recycled air compared to the other trainees. Crowding could also contribute to differing environmental conditions. However, Squadron 320 did not have the highest number of trainees among the squadrons, so this explanation is unlikely to justify the apparent difference. We were not able to explore squadron-specific environmental conditions.

The final analyses were stratified by squadron because of the presence of interaction between Squadron 320 and hospitalization. Final analyses were also adjusted for age and gender to prevent potential confounding by these variables. After adjusting for age and gender and stratifying by squadron, having any clinic or ED visit (excluding respiratory visits within 4 days of hospitalization and post-hospitalization visits among those who were admitted) was not significantly positively associated with hospitalization in any squadron. These results suggest that the clinic setting did not represent an important factor in the likelihood of hospitalization for FRI during this outbreak.

Having had one or more respiratory visits (excluding all visits within four days of hospitalization and all visits after hospitalization in trainees who were admitted) was significantly protective in Squadrons 320, 321, 323 and 324. The reason for this finding is unknown. Trainees who sought medical attention for mild respiratory symptoms may have been given medications that suppressed their symptoms. Since admission criteria rely on symptomology, these trainees may have been less likely to be admitted than if they had not received symptom-suppressing medications. Suppression of symptoms may have caused the individuals to not meet the admission criteria or may have decreased the likelihood of seeking care. Perhaps trainees who experienced mild respiratory illness were less likely to subsequently become severely ill due to a modified immune response generated by earlier exposures to pathogens. These results suggest that prior respiratory illness (mild enough to not warrant hospitalization) was not associated with subsequent hospitalization and, in fact, may have been protective against it. No information on etiologic pathogens is available for those earlier "milder" respiratory illnesses that triggered care-seeking but not hospitalization.

This study had several limitations. First, it relied on the health care-seeking behavior of trainees, which is probably influenced in turn by the attitudes of the MTIs. We were not able to assess or control for either of these factors. The dependent variable also relied on the provider's decision to admit the trainees. While we could not evaluate the influence of this factor directly, our study period was chosen in part because it represents a time period when the formal admission policies were constant. Moreover, each satellite clinic provides care for more than one squadron (Reid clinic only provides care for Squadron 324), so provider decisions should not, in general, be squadron-specific. Because we used electronic medical records, our data were subject to ICD-9 coding biases. However, since multiple squadrons attend satellite clinics B and C, coding biases should not be squadron-specific either. Another potential limitation is the fact that we assumed a relatively short incubation period for febrile respiratory illness. We based the 4-day incubation period for adenovirus on prior studies (Bell, et al., 1956; Couch, et al., 1966). Because there is always an incubation period range, it is possible that we included visits that were associated with the admission-related illness. However, given what is known about adenovirus and febrile

respiratory illness, 4 days is a biologically and medically reasonable cut-off point. Finally, our study was performed during a 13-week period and, therefore, may not be representative of the entire outbreak.

The use of hospitalization as a surrogate for infection introduces another limitation. As was subsequently discovered and noted in the "Seroconversion" section, many infections did not result in care-seeking behavior. Hence, many trainees who may have experienced adenovirus infections that were "mild" enough to not trigger a hospitalization would be misclassified into the "non-infected" category. No attempt was made to ascertain adenovirus infections among those not seeking care.

Economic impact

Introduction: One of the prime motivators triggering an external evaluation of the FRI outbreak among trainees was the apparent high cost of hospitalization. The large number of trainees requiring hospitalization necessitated the opening of a new inpatient ward at Wilford Hall Medical Center with attendant staffing and direct care costs. At times, even this ward's capacity was exceeded, resulting in the use of bed capacity within other hospital wards. The potential existed for cancellation of elective surgeries and diversion of otherwise eligible beneficiaries to civilian hospitals for care; whether this actually occurred or not is unclear. This cursory evaluation of costs was undertaken in an attempt to document the economic impact of the outbreak.

Methods: Hospitalization and lost training costs were calculated based on the length of stay derived from the inpatient record review (see "Severity of clinical syndrome" section of this report) and the average internal medicine inpatient bed-day cost. The actual cost of the recruits' hospitalizations could not be directly determined at the time of the investigation for two reasons. First, until the first part of April, the trainees were hospitalized under observation without formal admission to the hospital, and no records were kept of the length of stay. Second, there is a 1-2 month time lag in establishment of direct costs for each admission, so even after the hospitalizations became classified as true admissions, the actual cost information was not available for a period of time. Because of these limitations, the cost per hospital day was estimated based on average internal medicine bed day costs for WHMC. In retrospect, these costs represented an overestimation of true costs because these generally healthy trainees did not require the same level of care as a typical internal medicine inpatient would. After the outbreak investigation was concluded, a second estimation of costs was made using actual MEPRS cost data obtained from the resource management office at WHMC.

The 37 TRW staff determined that the cost of a lost training day for basic trainees was $110 per day. Other potential costs not evaluated include the following:

- Potential lost admissions. The large number of trainees being hospitalized sometimes caused overflows from the ward established for the trainees. This overflow took up beds on other wards. Beneficiaries otherwise eligible for inpatient care at WHMC could have been sent to another facility due to lack of hospital beds.

- Loss of residency training cases. Due to the saturation of the system with generally healthy trainees, proportionally less time could have been spent with more complex patients.

- Lost provider productivity. Staff physicians were required to supervise the trainee inpatient ward on a rotating basis. Those staff members could not see patients in their clinics while they were staffing the inpatient ward.

- Morbidity. No attempt was made to evaluate in monetary terms the morbidity suffered by the individual trainees.

Results: The average cost for an internal medicine bed-day was given as $1340. Based on the inpatient record review (see page 10), the average length of stay was 2.7 days. Each hospitalization was therefore estimated to cost $3618. Total costs naturally depend on the number of admissions: from 24 Nov 99 through 31 May 00, there was an average of 7.3 admissions each day (minimum of 1 and maximum of 24 admissions per day). If each admission cost $3618, the resulting hospitalization costs were $26,411 per day. Including 3 days of lost training per admission at $110 per day adds $2409 for the 7.3 admissions each day, yielding a sum of $28,820 per day. It became obvious that this large cost was an overestimate.

Revised cost estimates used a per-person average of actual MEPRS costs provided by the WHMC Resource Management Office. MEPRS costs include fixed costs, such as contract nurses and utilities charges, as well as variable costs such as medications, radiographic examinations, and laboratory testing. A higher patient census drives down per-patient costs. Hence, the per-patient MEPRS costs varied month to month. The following average MEPRS cost per admission were reported for the following months: April 00: $237; May 00: $205; June 00: $213; July 00: $452; August 00: $521. The average cost during this period was $325 per-admission. Adding the $330 dollars of lost training costs per admission yields a reasonable estimate of the average cost of $655 per admission. During this time period of 24 Nov 99 through 30 Aug 00, there were 1,371 admissions, costing an estimated $898,000 in direct hospital and lost training.

Discussion: This cost analysis is cursory, does not include all costs, and is at best a gross estimate. Even by the revised cost figures, hospitalization of the trainees during this outbreak developed into a costly experience. These costs are fairly low as far as hospitalization costs go, since the generally young, healthy nature of recruits minimizes the need for medical services other than observation. Although no cost-benefit analysis was attempted, one could argue that the costs associated with a propagated outbreak such as this would justify an investment in reasonable intervention efforts focused on this population.

Final Intervention recommendations

Introduction: The goal of this outbreak investigation was to find feasible interventions that would decrease adenovirus transmission and make those recommendations to appropriate commanders. Since the adenovirus vaccine was no longer available for use, nonvaccine interventions would be necessary.

Methods: A list of 21 intervention recommendations in 9 categories was developed based on the findings of both the studies and references described in this document. The findings and the list of recommendations were presented to the 59 MDW Board of Directors on 12 Jun 00 and to the 37 TRW's Trainee Health Committee on 23 Jun 00.

Results: Intervention recommendations are provided in Appendix L.

Discussion: The intervention recommendations varied from simple and quick, such as moving the location of a handwashing station in a field training area, to more complex, such as a study of the use of antimicrobial hand wipes. The interventions were intended to be accomplishable rather than unrealistic, such as reengineering the air-handling units of the classrooms. It was not the charter or intention of this investigation to conduct ongoing evaluations of the implementation and subsequent success of these interventions.

The general lack of evidence for the effectiveness of nonvaccine interventions prohibited a securely confident recommendation for action on the proposed interventions. None of the recent adenovirus outbreaks in military training centers has generated peer-reviewed, published data on interventions. In that sense, all the interventions recommended by AFIERA/RSRH could be considered theoretical. Recommendation: resources should be made available to conduct well-designed studies of interventions in this or similar populations.

SUMMARY DISCUSSION

Trainees at Lackland AFB experienced and continue to experience excess morbidity due to an ongoing outbreak of adenovirus. While this health issue has been previously recognized in the other services, it had not been recognized in the Air Force recruit population before the outbreak described here. A clinical description of the outbreak was compiled by review of medical records; perhaps the single most concise indication of the relative morbidity was the finding of a mean max oral temperature of 102.4 F among hospitalized trainees, indicating that the infection was more than "just a cold." A risk factor questionnaire was administered in an attempt to identify potential areas for public health intervention, and the results showed a generally pervasive inadequacy of personal hygiene practices. Ongoing surveillance was established to track the outbreak among basic trainees, using hospitalizations as a surrogate for disease activity. A large number of trainees were hospitalized for acute febrile respiratory illness during this study period, with rates reaching 26 per 1000 trainees per week. A limited assessment of the IAQ of the dorms and classrooms, measuring CO_2, humidity, and temperature, indicated that the classroom IAQ was poor during occupation of the rooms; sleeping areas had good IAQ in terms of the measured parameters. The point prevalence of adenovirus oropharyngeal carriage among BMTs was found to be an amazingly high 17%. Finally, a seroconversion study among a cohort of trainees showed that 39% of Air Force recruits who enter basic training without evidence of recent exposure to/infection with adenovirus eventually develop serologic evidence of exposure to or infection with adenovirus.

Initial recommendations were developed based on the findings, or preliminary findings, of these several studies and were intended to address ways to reduce the burden of respiratory disease among trainees. Suggestions were made for decreasing crowded conditions and mixing of

flights, improving personal hygiene and indoor air quality and limiting the role of fomites in disease transmission. Continuing surveillance of respiratory illness, elimination of real or perceived barriers to sick call access, and a more relaxed policy regarding disposable tissue use were all recommended. Initially, recommendations or suggestions for separating "ill" from "well" trainees in the clinics were included, however, these were subsequently downplayed when it became more apparent that symptoms were not clearly associated with adenovirus infection or carriage. The final and perhaps most important recommendation was that command authorities provide a position of strong advocacy for reestablishing the supply of adenovirus vaccine.

CONCLUSIONS

Acute febrile respiratory infections due to adenovirus occurred in epidemic proportions in this U.S. Air Force basic training population. The outbreak was propagated widely throughout the trainee population and propagation continued as this study concluded. Intervention recommendations are inferred from what has seemed to work well historically in general respiratory illness control. Also taken into consideration was the anecdotal experience of preventive medicine officers at the Army and Navy training centers; the other services have had more experience in adenovirus outbreaks than the Air Force has for unclear reasons. Clear evidence for nonvaccine intervention effectiveness in military training environments is lacking in the published literature. Until a source for adenovirus vaccine can be reestablished, the military training centers can expect ongoing outbreaks of acute febrile respiratory illness due to this pathogen.

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APPENDICES

APPENDIX A: TASKING LETTER

DEPARTMENT OF THE AIR FORCE
59th MEDICAL WING (AETC)

4 April 2000

Maj Gen E. Winters Mabry
Commander
2200 Bergquist Dr., Suite 1
Lackland AFB, TX 78236

Lt Col Kenneth Cox
Chief, Risk Assessment Division
AFIERA/RSR
2513 Kennedy Circle
Brooks AFB, TX 78235-5123

Dear Lt Col Cox,

1. Starting November 1999, an apparent outbreak of acute respiratory illness due predominantly to adenovirus type 4 has been occurring among Basic Military Trainees at Lackland AFB. Over 700 observation admissions have been generated necessitating the opening of an additional ward at the 59 MDW. This outbreak continues to have a significant impact on the training of Air Force recruits as well as the 59 MDW.

2. I am formally requesting assistance from AFIERA/RSR in establishing the epidemiology of the outbreak and to assist in control measures that might terminate or relieve the impact of this epidemic. The designated AFIERA team chief has authority to conduct the investigation, including medical record reviews, questionnaires, person-to-person interviews, and other appropriate epidemiological methods. Should any invasive testing be considered necessary, such as drawing blood for serum testing, prior approval will be required.

3. My POC is Col Karen K. Wies, Deputy Chief of the Medical Staff. Col Wies can be reached at commercial (210) 292-6002 or DSN 554-6002.

E. Winters Mabry

E. WINTERS MABRY II
Major General, USAF, MC
Commander

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APPENDIX B: KEY PERSONNEL CONTACTED

a. Col Karen Wies, 59 MDW/CM
b. Lt Col Matt Dolan, 59 MDW/MMII
c. Maj Valerie Laurel, 59 MDW/MMII
d. Maj Ron Hale, 59 MDW/MRPHP
e. Maj David Duque, 59 MDW/MRPHP
f. Col Steve Grube, 59 MDW/MRPP
g. SSgt Pichardo, NCOIC, Ward 1A
h. Col Stef Eisen, 737 TRG/CC
i. Lt Col Stevenson Ray, 737 TRSS/CC
j. MSgt Ransom, 737 TRG scheduler
k. MSgt Blue, Warrior Week MTI
l. Maj Mader, 59MDW (Bioenvironmental Engineer)
m. COL Sanchez, Army Preventive Medicine Officer
n. CDR Megan Ryan, Naval Health Research Center
o. Dr. Joel Gaydos, DoD Global Emerging Infections System, WRAIR
p. CAPT Gregory Gray, Naval Health Research Center
q. Mr. James Wilbourn, Chief, Evaluation and Analysis Element, Air Education and Training Command, 737th Training Group
r. Lt Col Richard Baskin, 37 TRSS/CC, Lackland AFB
s. SSgt Suzanne Bond, 59 AMS/MRPP, Lackland AFB
t. SSgt George Viale, 859 MDTS/MTLLC, Lackland AFB
u. Brig Gen Sharla Cook, 82 TW/CC, Sheppard AFB
v. Maj Gregory Bobel, 82 MDSS/SGPM, Sheppard AFB
w. Maj Oswald Johnson, 82 MDSS/SGPM, Sheppard AFB
x. Col Robbie Bryant, 81 TG/CC, Keesler AFB
y. Maj Jeffrey Lamothe, 81 MDSS/SGSC, Keesler AFB
z. TSgt James Davis, 81 MDSS/SGPM, Keesler AFB
aa. Ms. Sylvia Trevino, AFIERA/SDE, Brooks AFB
bb. TSgt Russell Thomas, 81 MDSS/SGSC, Keesler AFB
cc. TSgt Robert Randall, 82 MDSS/SGSCL, Sheppard AFB
dd. SrA Liza Mar, 859 MDTS/MTLLC, Lackland AFB

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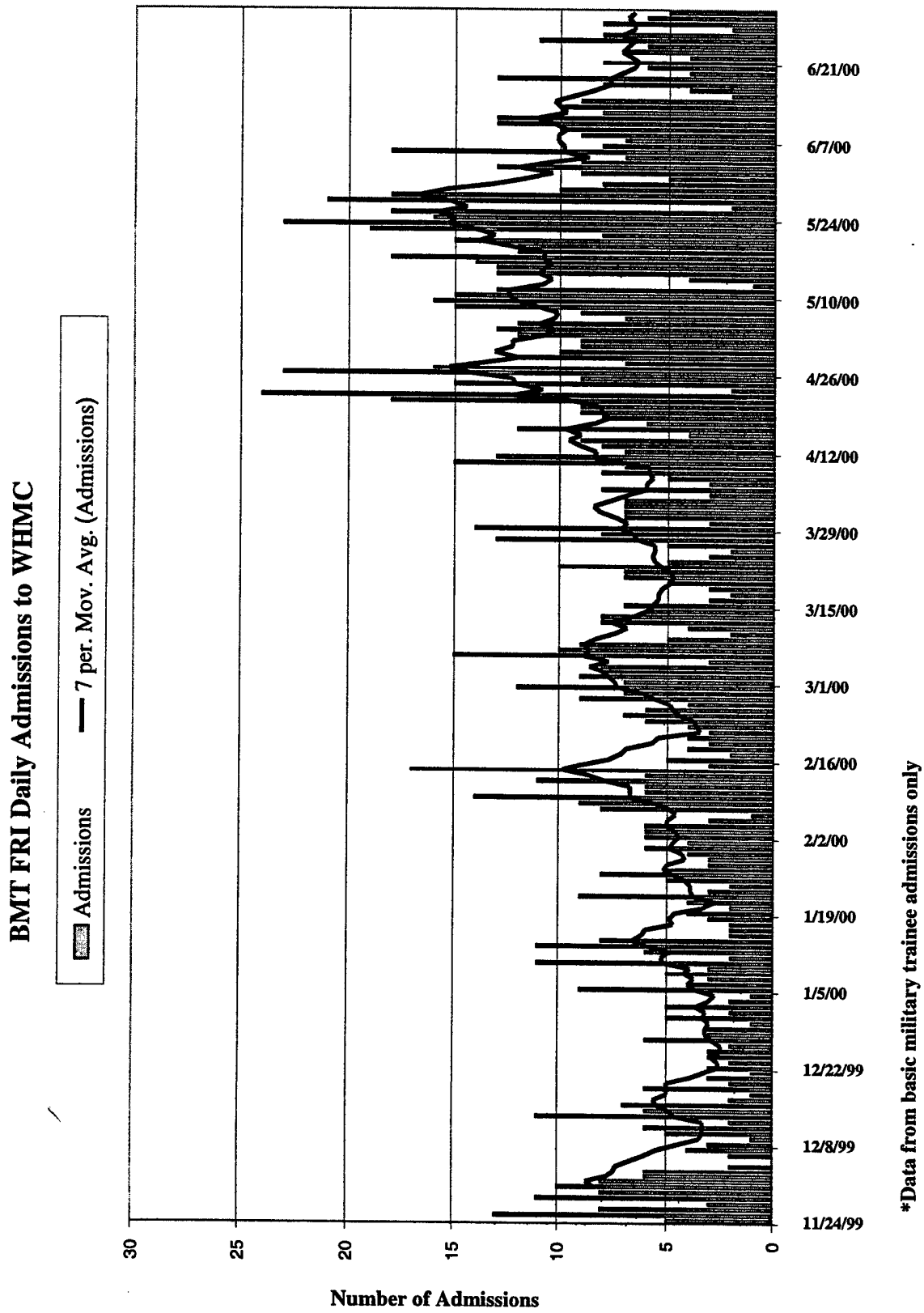
APPENDIX C: DAILY FRI HOSPITALIZATIONS TREND



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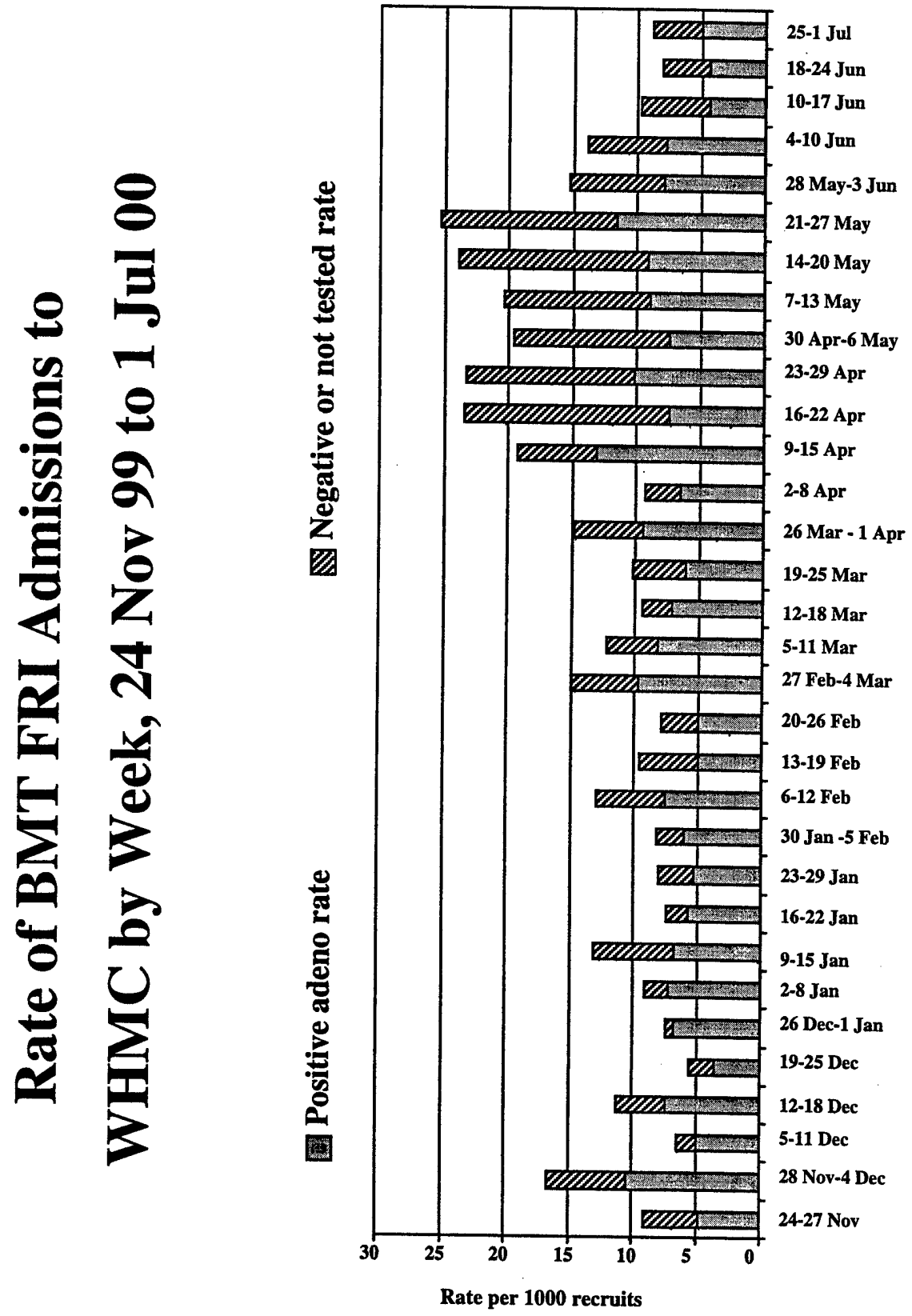
APPENDIX D: WEEKLY FRI HOSPITALIZATIONS TREND



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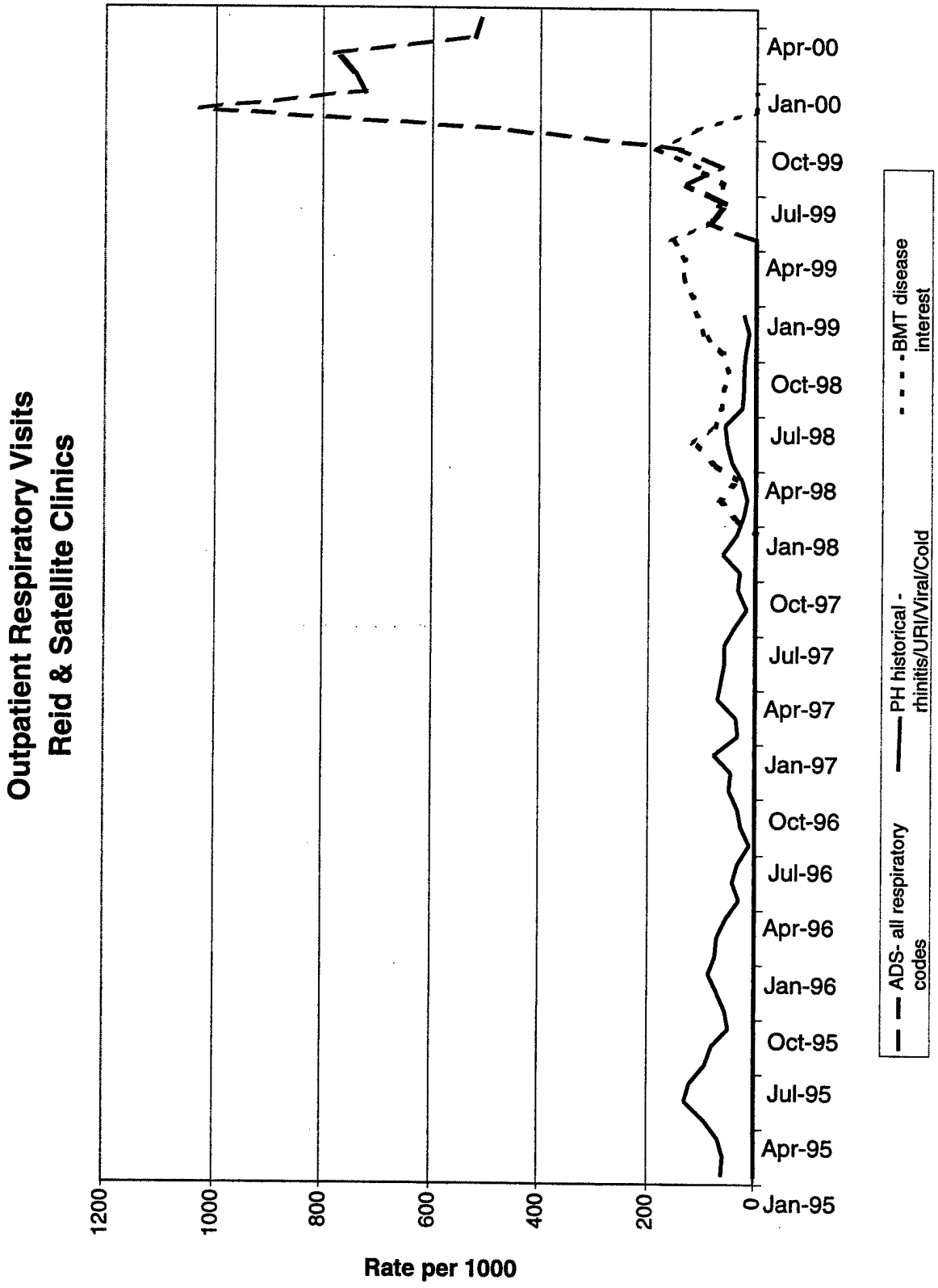
APPENDIX E: HISTORICAL RESPIRATORY DISEASE DATA



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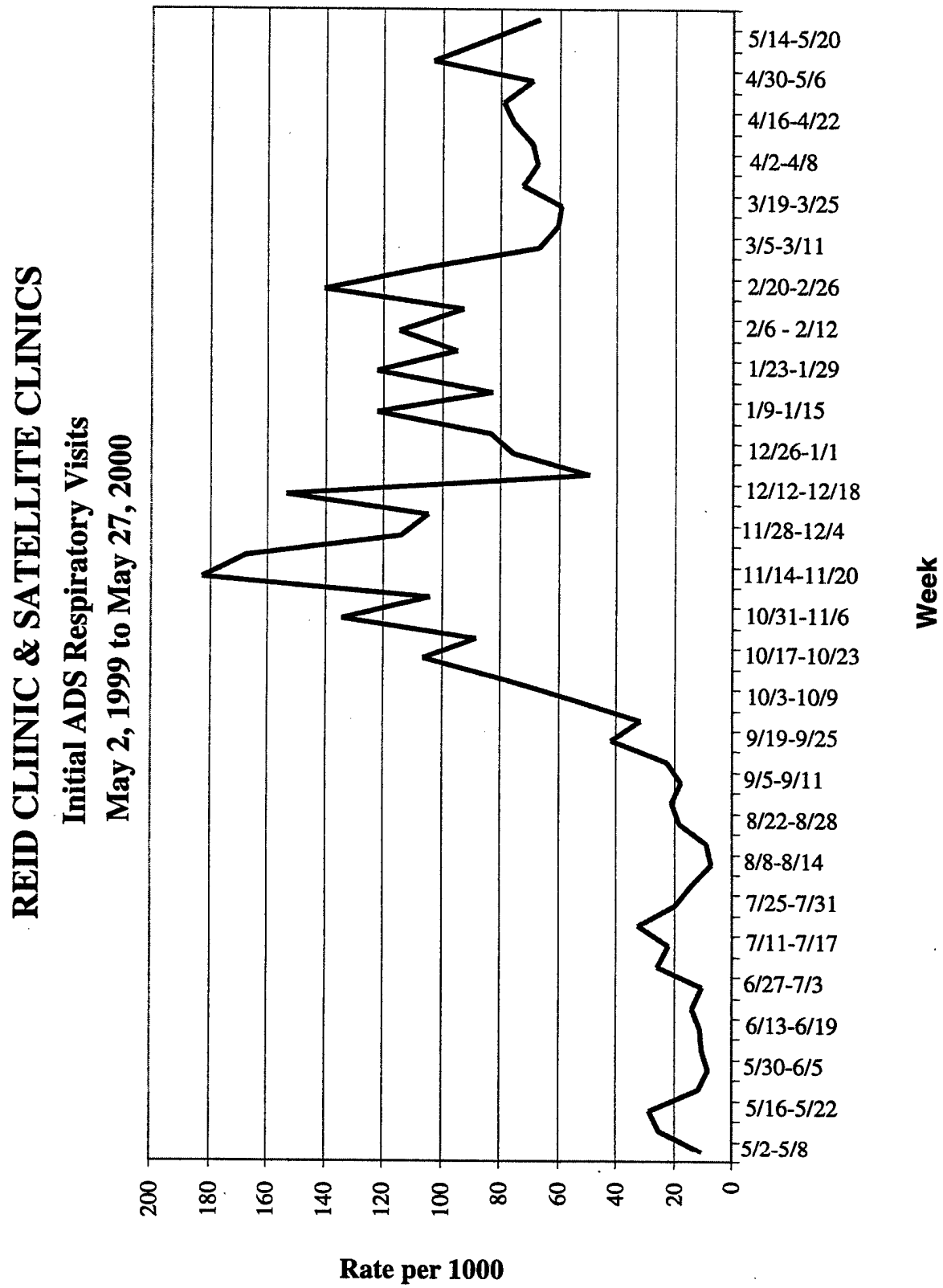
APPENDIX F: HISTORICAL RESPIRATORY DISEASE DATA



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APPENDIX G-1: QUESTIONNAIRE FOR INPATIENT TRAINEES

The Force Health Protection and Surveillance Branch at Brooks AFB is evaluating respiratory illnesses that occur during basic training. Your assistance and consent in filling out this survey is greatly appreciated. This survey is **completely anonymous**, so no personal information can be used.

SECTION I: General Questions

Instructions: Please circle, check or fill in the appropriate answer or answers.

1. **What is your age?** _____

2. **What is your gender?** **Male** **Female**

3. **What date did you arrive at Lackland AFB?** _____

4. **When do you expect to graduate?** _____

5. **What flight and squadron are you in?** **Flight#**_____ **Squadron#**_____

6. **What dorm are you in?** _____

7. **Where did you live immediately before you began your military training at Lackland AFB?**

   City_____ **State**_____

8. **Do you have a high school diploma or GED?** Yes No

9. **Please circle any of the following symptoms you have experienced during your training at Lackland AFB that were associated with a cold or flu-like illness (If none, skip to question #10):**

   Fever Stuffy/Runny Nose Sore Throat Hoarseness Headache

   Aches Dizziness Itchy/Draining Eyes Cough Other_____

   9a. What week of training did your symptoms start?

   Week 1 Week 2 Week 3 Week 4 Week 5 Week 6

10. **Were you admitted to the hospital at any time during training for a respiratory illness (cold or flu symptoms, but not allergies)(If no, skip to question #11)?**

    Yes No

    10a. What week of training were you admitted to the hospital?

    Week 1 Week 2 Week 3 Week 4 Week 5 Week 6

11. **To your knowledge, have you been around anyone who had a respiratory illness (cold or flu symptoms, but not allergies) during training?**

Yes No Don't know

12. **Have you smoked tobacco on a regular basis during the past year?**

Yes No

SECTION II: Training Weeks 1-4

Instructions: Please circle, check or fill in the appropriate answer or answers. These questions concern any/all training weeks **except for** Warrior Week.

13. **During training (excluding Warrior Week) how often do you do the following?**

Wash hands after sneezing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after coughing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after using the restroom:	Always	Usually	Sometimes	Rarely/Never
Wash hands before eating:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when sneezing:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when coughing:	Always	Usually	Sometimes	Rarely/Never
Share a canteen:	Always	Usually	Sometimes	Rarely/Never
Share drink, food (including snacks or soda), toothbrush or utensils:	Always	Usually	Sometimes	Rarely/Never
Share towels:	Always	Usually	Sometimes	Rarely/Never

On average, how many times each day do you wash your hands (excluding Warrior Week)? _____

14. **Please indicate how many times per week you do the following during training (other than Warrior Week):**

Shower	0	1-2	3-4	5-6	7 or more
Brush your teeth	0	1-2	3-4	5-6	7 or more
Get issued clean bed linens	0	1-2	3-4	5-6	7 or more
Wash your towels	0	1-2	3-4	5-6	7 or more
Wear a clean uniform	0	1-2	3-4	5-6	7 or more
Get issued a clean blanket	0	1-2	3-4	5-6	7 or more

15. **During training (other than Warrior Week) how often have you used bed linens that were previously used by someone else (without laundering between use)?**

Never Rarely Sometimes Often Don't Know

16. **During training (other than Warrior Week) how often have you used towels that were previously used by someone else (without laundering between use)?**

Never Rarely Sometimes Often Don't Know

17. **How would you rate the level of emotional, physical and mental stress you are under during training (excluding Warrior Week)?**

No stress Low stress Medium stress High stress Extremely high stress

18. **During training (excluding Warrior Week), how would you rate your chance of getting a respiratory illness (cold or flu symptoms, but not allergies) compared to before you began your training at Lackland?**

Much lower Lower Same Higher Much higher

SECTION III: Warrior Week

Instructions: Please circle, check or fill in the appropriate answer or answers. These questions only concern Warrior Week. **If you have not yet been through Warrior Week, please skip to section IV.**

19. **During Warrior Week how often do you do the following?**

Wash hands after sneezing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after coughing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after using the restroom:	Always	Usually	Sometimes	Rarely/Never
Wash hands before eating:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when sneezing:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when coughing:	Always	Usually	Sometimes	Rarely/Never
Share a canteen:	Always	Usually	Sometimes	Rarely/Never
Share drink, food (including snacks or soda), toothbrush or utensils:	Always	Usually	Sometimes	Rarely/Never
Share towels:	Always	Usually	Sometimes	Rarely/Never
Share a gas mask (without cleaning):	Always	Usually	Sometimes	Rarely/Never

On average, how many times each day do you wash your hands? _____

20. **Please indicate how many times per week you do the following during Warrior Week:**

Shower	0	1-2	3-4	5-6	7 or more
Brush your teeth	0	1-2	3-4	5-6	7 or more
Wash your towels	0	1-2	3-4	5-6	7 or more
Wear a clean uniform	0	1-2	3-4	5-6	7 or more

21. **During Warrior Week, how often have you used sleeping bags that were previously used by someone else (without laundering between use)?**

Never Rarely Sometimes Often Don't Know

22. **During Warrior Week, how often have you used towels that were previously used by someone else (without laundering between use)?**

Never Rarely Sometimes Often Don't Know

23. **How would you rate the level of emotional, physical and mental stress you are under during Warrior Week?**

No stress Low stress Medium stress High stress Extremely high stress

24. **During Warrior Week, how would you rate your chance of getting a respiratory illness (cold or flu symptoms, but not allergies) compared to before you began your training at Lackland?**

Much lower Lower Same Higher Much higher

SECTION IV: General Questions

Instructions: Please circle, check or fill in the appropriate answer or answers.

25. **During training, how often have you been instructed about personal hygiene (e.g. handwashing, bathing etc.)?**

Never One time A Few Times Many Times

26. **What sorts of things have you seen or have you heard of people doing to reduce cleaning time for inspections?**

Limit the number of sinks used	Yes	No
Limit the amount of soap used	Yes	No
Limit the number of toilets used	Yes	No
Limit sink activity (e.g. for washing hands)	Yes	No

Other:_____

_____

_____

27. **Do you usually sleep:**

___Under the blanket/sleeping bag and between the sheets ___On top of the blanket/sleeping bag and sheets

28. **For this study, we are looking into respiratory illness among trainees and are hoping to find a way to prevent it. Since you have first-hand experience as a trainee, how do you think respiratory illness could be reduced or prevented during training?**

29. **As a trainee, have you observed or heard of any other unsanitary practices that could lead to the spread of respiratory illness during training?**

30. **Please write any additional comments:**

Thank you for completing this questionnaire!

APPENDIX G-2: QUESTIONNAIRE FOR MTI'S

The Force Health Protection and Surveillance Branch at Brooks AFB is evaluating respiratory illnesses that occur during basic training. Your assistance and consent in filling out this survey is greatly appreciated. This survey is **completely anonymous**, so no personal information can be used.

SECTION I: General Questions

Instructions: Please circle, check or fill in the appropriate answer or answers.

1. **What is your age?** _____

2. **Are you a:** _____**Street MTI** _____**Warrior Week MTI** _____**IDMT**

3. **What is your gender?** **Male** **Female**

4. **What month and year did you become a MTI?** _____

5. **What flight(s) have you trained since 1-Oct-99?**
_____

6. **Please circle any of the following symptoms you have experienced since Oct-1-99 that were associated with a cold or flu-like illness (If none, skip to question #7):**

Fever Nasal Congestion Sore Throat Hoarseness Headache

Aches Dizziness Itchy/Draining Eyes Cough Other_____

7. **Were you admitted to the hospital since 1-Oct-99 for a respiratory illness (If no, skip to question #8)?**

Yes No

7a. What date(s) were you admitted to the hospital? _____

8. **What dorm(s) do you spend most of your time in?** _____

9. **To your knowledge, since 1-Oct-99 have you been exposed to anyone who had a respiratory illness (If no, skip to question # 10)?**

Yes No Don't know

9a. If yes, where were you exposed? On base Off base Don't know

10. **Do you currently smoke on a regular basis or have you smoked cigarettes on a regular basis during the past year (If no, skip to question # 11)?**

Yes No

10a. If yes, do you share lighted cigarettes with anyone? Yes No

11. **How many cold packs have you requested <u>for yourself</u> since 1-Oct-99?** _____

SECTION II: Weeks 1-4 and Week 6

If you are a Warrior Week MTI, please skip to Section III.

Instructions: Please circle, check or fill in the appropriate answer or answers. These questions concern any/all training weeks except for Warrior Week.

12. During the training cycle (other than Warrior Week) how often are you able/do you do the following?

Wash hands after sneezing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after coughing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after using the restroom:	Always	Usually	Sometimes	Rarely/Never
Wash hands before eating:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when sneezing:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when coughing:	Always	Usually	Sometimes	Rarely/Never

On average, how many times each day do you wash your hands? _____

13. Based on your observations and/or opinion, how many times each day do you think the trainees wash their hands during training (excluding Warrior Week)?

_____Do not wash hands at least once each day
_____Wash hands 1-2 times each day
_____Wash hands 3-5 times each day
_____Wash hands more than 5 times each day
_____Don't know

14. To your knowledge, during training (other than Warrior Week) how often do the trainees use bed linens that were previously used by someone else (without laundering between use)?

Never Rarely Sometimes Often Don't know

15. To your knowledge, during training (other than Warrior Week) how often do the trainees use towels that were previously used by someone else (without laundering between use)?

Never Rarely Sometimes Often Don't know

16. To your knowledge, during training (other than Warrior Week) how often do the trainees share or swap canteens with anyone else?

Never Rarely Sometimes Often Don't know

17. During training (excluding Warrior Week) how often do you instruct your flight on personal hygiene (e.g. handwashing etc.)?

Never One Time Several Times Many Times

SECTION III: Warrior Week

If you are a Street MTI, please skip to Section IV.

Instructions: Please circle, check or fill in the appropriate answer or answers. These questions only concern Warrior Week.

18. During Warrior Week how often are you able to/do you do the following?

Wash hands after sneezing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after coughing:	Always	Usually	Sometimes	Rarely/Never
Wash hands after using the restroom:	Always	Usually	Sometimes	Rarely/Never
Wash hands before eating:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when sneezing:	Always	Usually	Sometimes	Rarely/Never
Use a tissue when coughing:	Always	Usually	Sometimes	Rarely/Never

On average, how many times <u>each day</u> do you wash your hands? _____

19. Based on your observations and/or opinion, how many times <u>each day</u> do you think the <u>trainees</u> wash their hands during training during Warrior Week?

_____Do not wash hands at least once each day
_____Wash hands 1-2 times each day
_____Wash hands 3-5 times each day
_____Wash hands more than 5 times each day
_____Don't know

20. To your knowledge, how often do the trainees use sleeping bags that were previously used by someone else (without laundering between use) during Warrior Week?

Never Rarely Sometimes Often Don't know

21. To your knowledge, how often do the trainees use towels that were previously used by someone else (without laundering between use) during Warrior Week?

Never Rarely Sometimes Often Don't know

22. To your knowledge, how often do the trainees share or swap canteens with anyone else during Warrior Week?

Never Rarely Sometimes Often Don't know

23. During Warrior Week, how often do you instruct your flight on personal hygiene (e.g. handwashing etc.)?

Never One Time Several Times Many Times

SECTION IV: GENERAL QUESTIONS

Instructions: Please circle, check or fill in the appropriate answer or answers.

24. Realistically, do you know or suspect that the trainees do any of the following to reduce cleaning time for inspections:

Limit the number of sinks used	Yes	No
Limit the amount of soap used	Yes	No
Limit the number of toilets used	Yes	No
Limit sink activity (e.g. for washing hands)	Yes	No

Other:_____

25. During your job as a MTI, how would you rate your chance of getting a respiratory illness compared to before you became a MTI?

Much lower Lower Same Higher Much higher

26. For this study, we are looking into respiratory illness among trainees, MTIs and IDMTs and are hoping to find a way to prevent it. Since you have first-hand experience as a MTI, how do you think respiratory illness could be reduced or prevented during training?

27. Can you make any suggestions for changes in the training activities, schedule, practices or facilities that may help prevent the spread of respiratory illness during training?

28. **Please include any additional comments you may have:**

Thank you for completing this questionnaire!

APPENDIX G-3: QUESTIONNAIRE FOR TRAINEES, BUBBLE SHEET SECTION

The Force Health Protection and Surveillance Branch at Brooks AFB is evaluating respiratory illnesses that occur during basic training. Your assistance and consent in filling out this survey is greatly appreciated. This survey is **completely anonymous**, so no personal information can be used.

In order to ensure anonymity, do **not** fill in any of the spaces on the left- hand side of the bubble sheet (name, birth date, identification number, sex or grade/education).

SECTION I: General Questions

INSTRUCTIONS: Please fill in the correct answer on your bubble sheet.

1. What is your gender?

   A. Male
   B. Female

2. During your training at Lackland AFB have you experienced a **fever** that was associated with a cold or flu-like illness?

   A. Yes
   B. No

8. During your training at Lackland AFB have you experienced a **sore throat** that was associated with a cold or flu-like illness?

   A. Yes
   B. No

4. During your training at Lackland AFB have you experienced a **stuffy or runny nose** that was associated with a cold or flu-like illness?

   A. Yes
   B. No

5. During your training at Lackland AFB have you experienced **hoarseness** that was associated with a cold or flu-like illness?

   A. Yes
   B. No

6. During your training at Lackland AFB have you experienced a **headache** that was associated with a cold or flu-like illness?

   A. Yes
   B. No

7. During your training at Lackland AFB have you experienced any **body aches** that were associated with a cold or flu-like illness?

   A. Yes

B. No

8. During your training at Lackland AFB have you experienced any **dizziness** that was associated with a cold or flu-like illness?

A. Yes
B. No

9. During your training at Lackland AFB have you experienced **itchy or draining eyes** that were associated with a cold or flu-like illness?

A. Yes
B. No

10. During your training at Lackland AFB have you experienced a **cough** that was associated with a cold or flu-like illness?

A. Yes
B. No

11. What week of training did your symptoms **start**?

A. Week 1
B. Week 2
C. Week 3
D. Week 4
E. Week 5
F. Week 6

12. Were you admitted to the hospital at any time during training for a respiratory illness (cold or flu symptoms, but not allergies)(If no, skip to question #14)?

A. Yes
B. No

13. What week of training were you admitted to the hospital?

A. Week 1
B. Week 2
C. Week 3
D. Week 4
E. Week 5
F. Week 6

14. To your knowledge, have you been around anyone who had a respiratory illness (cold or flu symptoms, but not allergies) during training?

A. Yes
B. No
C. Don't know

15. Have you smoked tobacco on a regular basis during the past year?

A. Yes
B. No

16. During training, how often have you been instructed about personal hygiene (e.g. handwashing, bathing etc.)?

A. Never
B. One time
C. A Few Times
D. Many Times

17. Have you seen or have you heard of people limiting the number of sinks used to reduce cleaning time for inspections?

A. Yes
B. No

18. Have you seen or have you heard of people limiting the amount of soap used to reduce cleaning time for inspections?

A. Yes
B. No

19. Have you seen or have you heard of people limiting sink activity (e.g. for washing hands) to reduce cleaning time for inspections?

A. Yes
B. No

20. Do you usually sleep:

A. Under the blanket/sleeping bag and between the sheets
B. On top of the blanket/sleeping bag and sheets

SECTION II: Training Weeks 1-4

INSTRUCTIONS: These questions concern training weeks 1-4 (<u>not</u> Warrior Week). Please fill in the correct answer on your bubble sheet.

21. During training (excluding Warrior Week) how often do you **wash your hands after sneezing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

22. During training (excluding Warrior Week) how often do you **wash your hands after coughing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

23. During training (excluding Warrior Week) how often do you wash your hands after **using the restroom**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

24. During training (excluding Warrior Week) how often do you **wash your hands before eating**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

25. During training (excluding Warrior Week) how often do you **use a tissue when sneezing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

26. During training (excluding Warrior Week) how often do you **use a tissue when coughing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

27. During training (excluding Warrior Week) how often do you **share a canteen**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

28. During training (excluding Warrior Week) how often do you **share a drink (including soda), food (including snacks), a toothbrush or utensils?**

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

29. During training (excluding Warrior Week) how often do you **share a towel**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

30. Please indicate how many times per week you **shower** during training (other than Warrior Week):

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

31. Please indicate how many times per week you **brush your teeth** during training (other than Warrior Week):

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

32. Please indicate how many times per week you **get clean bed linens issued** during training (other than Warrior Week):

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

33. Please indicate how many times per week you **wash your towels** during training (other than Warrior Week):

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

34. Please indicate how many times per week you **wear a clean uniform** during training (other than Warrior Week):

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

35. Please indicate how many times per week you **get issued a clean blanket** during training (other than Warrior Week):

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

36. During training (other than Warrior Week) how often have you used bed linens that were previously used by someone else (without laundering between use)?

A. Never
B. Rarely
C. Sometimes
D. Often
E. Don't Know

37. During training (other than Warrior Week) how often have you used towels that were previously used by someone else (without laundering between use)?

A. Never
B. Rarely
C. Sometimes
D. Often
E. Don't know

38. How would you rate the level of emotional, physical and mental stress you are under during training (excluding Warrior Week)?

A. No stress
B. Low stress
C. Medium stress
D. High stress
E. Extremely high stress

39. During training (excluding Warrior Week), how would you rate your chance of getting a respiratory illness (cold or flu symptoms, but not allergies) compared to before you began your training at Lackland?

A. Much lower
B. Lower
C. Same
D. Higher
E. Much higher

SECTION III: Warrior Week

INSTRUCTIONS: These questions only concern Warrior Week. Skip this section if you have not yet started Warrior Week. Please fill in the correct answer on your bubble sheet.

40. During warrior Week, how often do you **wash your hands after sneezing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

41. During Warrior Week, how often do you **wash your hands after coughing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

D. Rarely/Never

50. Please indicate how many times you **shower** during Warrior Week:

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

51. Please indicate how many times you **brush your teeth** during Warrior Week:

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

52. Please indicate how many times you **wash your towels** during Warrior Week:

A. 0
B. 1-2
C. 3-4
D. 5-6
E. 7 or more

53. During Warrior Week, how often have you used towels that were previously used by someone else (without laundering between use)?

A. Never
B. Rarely
C. Sometimes
D. Often
E. Don't Know

54. How would you rate the level of emotional, physical and mental stress you are under during Warrior Week?

A. No stress
B. Low stress
C. Medium stress
D. High stress
E. Extremely high stress

55. During Warrior Week, how would you rate your chance of getting a respiratory illness (cold or flu symptoms, but not allergies) compared to before you began your training at Lackland?

A. Much lower
B. Lower
C. Same
D. Higher
E. Much higher

Thank you for completing this questionnaire!

42. During Warrior Week, how often do you **wash your hands after using the restroom**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

43. During Warrior Week, how often do you **wash your hands before eating**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

44. During Warrior Week, how often do you **use a tissue when sneezing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

45. During Warrior Week, how often do you **use a tissue when coughing**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

46. During Warrior Week, how often do you **share a canteen**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

47. During Warrior Week, how often do you **share drink (including soda), food (including snacks), toothbrush or utensils?**

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

48. During Warrior Week, how often do you **share towels**?

A. Always
B. Usually
C. Sometimes
D. Rarely/Never

49. During Warrior Week, how often do you **share a gas mask (without cleaning)**?

A. Always
B. Usually
C. Sometimes

APPENDIX G-4: QUESTIONNAIRE FOR TRAINEES-WRITTEN SECTION

The Force Health Protection and Surveillance Branch at Brooks AFB is evaluating respiratory illnesses that occur during basic training. Your assistance and consent in filling out this survey is greatly appreciated. This survey is **completely anonymous**, so no personal information can be used.

Instructions: Please write your response in the space provided after each question.

1. What is your age? _____

9. What date did you arrive at Lackland AFB? _____

10. When do you expect to graduate? _____

11. What flight and squadron are you in? Flight#_____ Squadron#_____

12. What dorm are you in? _____

13. Where did you live immediately before you began your military training at Lackland AFB?

    City_____ State_____

7. On average, how many times <u>each day</u> do you wash your hands (excluding Warrior Week)? _____ times each day

8. On average, how many times <u>each day</u> during Warrior Week do you wash your hands? _____ times each day

9. Please describe any activities or behaviors you have heard of people doing or have seen people do in order to make cleaning easier or faster:

_____

_____

_____

_____

10. For this study, we are looking into respiratory illness among trainees and are hoping to find a way to prevent it. Since you have first-hand experience as a trainee, how do you think respiratory illness could be reduced or prevented during training?

_____

_____

_____

11. As a trainee, have you observed or heard of any other unsanitary practices that could lead to the spread of respiratory illness during training?

12. Please write any additional comments:

APPENDIX H: CODING RULES

Coding Responses to Open-Ended Questions

Number	Label	Sample of terms, phrases	Decision rules
1	Restricting number of showers	Limiting use to a few showerheads	Do not include: want a longer shower (#4); a personal shower stall would help; . . .
2	Restricting number of sinks	Limiting use to first/last 1-3 sinks	
3	Restricting number of stalls/toilets	Limiting use to first/last 1-3 stalls	
4	Limited time for showering	30 second showers, 10-15 minutes for 60 people	Do not include: a personal shower stall would help; . . .
5	Limited time for handwashing	Straight from PC or academic classes to chow w/o washing hands, using antimicrobial gels because not enough time	
6	Limited time for latrine/personal hygiene	Use this generic label if response can not fit in any of the more specific categories	
7	Not enough showers/toilets/sinks	Use this generic label if response can not fit in any of the more specific categories	Do not include: Not enough time (label as #4,5,or 6) or self-restriction of facilities (label as #1,2,or 3)
8	Dusty Tents	Hard to breathe after sweeping	Do not include: lack of ventilation (label as #20)
9	Too many people in tents/sleeping bays		Do not include: more time to sleep (label as #21)
10	Dirty clothes/linens	Not washing clothes, wearing BDU's longer than instructed, never changing sheets on bed.	Do not include: Sharing of linens/clothes (label as #11)
11	Sharing of items	Sharing towels, lines, canteens, toothbrushes, utensils, etc	
12	TIs not checking on hygiene	Not watching/monitoring recruits to make sure they are washing hands, not asking if sick	Do not include: not sending recruits to sick call (label as #16)

14	Not enough cleaning materials to clean facilities	Dusting down tents/latrines with bare hands	
15	Not enough cleaning materials to clean recruits	Soap in latrines always runs out, not enough paper towels to dry hands	
16	Not going to sick call or requesting cold packs	Not going to sick call when showing symptoms, sick call takes too much time out of training, fear of recycling, inadequate meds/visits	
17	Coughing/Sneezing w/o covering mouth/nose	Not covering mouth/nose	Do not include: TIs not allowing covering of mouth (label as #18)
18	TIs not allowing sneezing in tissue/ washing of hands or allowing recruits to go to sickcall	Not able to keep tissue out and available in dorm, being told to sneeze on neck of person in front of recruits (in formation)	Do not include: Not enough time (label as #4,5,or 6) or self-restriction of facilities (label as #1,2,or 3)
19	Poor personal hygiene	Not taking showers, only wetting themselves in showers, using baby wipes instead of showering, washing hands in toilet water	Do not include: using hand sanitizers to save time(#4); Not showering/washing to save time (label as #4 or #5)
20	Climate Control	Constant temperature changes in tents/dorms, lack of ventilation	
21	Not enough sleep/stress	Cleaning instead of sleeping, not enough hours to sleep, stress	
22	Other		

APPENDIX I: DNBI CATEGORY DEFINITIONS

Notes:

1. Count only the **initial** visit. Follow up visits are counted in the Miscellaneous/Administration/Follow-Up category.
2. All initial sick call visits will be placed in a category.
3. If in doubt about which category, make the best guess.
4. Estimate days of light duty, lost workdays, or admissions resulting from initial visits.
5. Format of these case definitions:
   a. Category Name and a brief operational definition
   b. Inclusion examples: sample (not exhaustive) diagnoses which this category includes
   c. Exclusion examples: used only when needed to provide sample diagnoses which are excluded (not covered) by this category.

Combat/Operational Stress Reactions – Acute reaction to stress and transient disorders occurring without any apparent mental disorder in response to exceptional physical and mental stress.
Includes: Acute Situational Stress Reactions, Battle Fatigue, Post Traumatic Stress Disorder (PTSD)
Excludes: depression, personality disorders, etc.

Dermatological – Diseases of the skin and subcutaneous tissue.
Includes: heat rash, fungal infection, cellulitis, impetigo, contact dermatitis, blisters, ingrown toenails, unspecified dermatitis, sunburn.

Gastrointestinal, Infectious – All diagnoses indicating *infection* of the intestinal tract.
Includes: all types of diarrhea, gastroenteritis, "stomach flu", nausea/vomiting, hepatitis, etc.
Excludes: non-infectious intestinal diagnoses such as hemorrhoids, ulcers.

Gynecological – Conditions related to the female reproductive system.
Includes: complications of pregnancy (bleeding, miscarriage, ectopic), menstrual abnormalities, vaginitis, and pelvic inflammatory disease.
Excludes: pregnancy (captured under Administrative), STD's (separate category).

Heat/Cold Injuries – Climate or environment associated injuries.
Includes: heat stroke, heat exhaustion, heat cramps, dehydration, hypothermia, frostbite, trench foot, immersion foot, and chilblain.

Injuries, Recreational/Sports – Any injury occurring as a direct consequence of the pursuit of personal and/or group fitness, excluding formal military training.

Injuries, Motor Vehicle Accidents – Any injury occurring as a direct consequence of a motor vehicle accident.

Injury, Other – Any injury not included in the previously defined injury categories.

Ophthalmologic – Any acute diagnosis involving the eye.
Includes: Pinkeye, conjunctivitis, sty, corneal abrasion, foreign body, acute vision problems.
Excludes: routine referral for glasses (non-acute), blunt/penetrating trauma (categorize under one of the Injury categories).

Psychiatric, Mental Disorders – Any defined psychiatric disorder as well as behavioral changes and disturbance of normal conduct which is either out of normal charchter, or is coupled with unusual physical symptoms such as paralysis.
Excludes: combat/operational stress reactions.

Respiratory – Any diagnosis of the upper and/or lower respiratory tract.
Includes: lower respiratory tract (bronchitis, pneumonia, emphysema, reactive airway disease, and pleurisy), upper respiratory tract ("common cold"/URI, laryngitis, tonsilitis, tracheitis, otitis and sinusitis.

Sexually Transmitted Disease – All sexually transmitted infections.
Includes: Chlamydia, HIV, gonorrhea, syphilis, herpes, chancroid, and venereal warts.
Excludes: PID (place under Gynecological).

Fever, Unexplained – Temperature of 100.5° F or greater for 24 hours, or history of chills and fever without a clear diagnosis (this is a screening category for many tropical diseases such as malaria, dengue fever, and typhoid fever). Such fever cannot be explained by other inflammatory/infectious processes such as respiratory infections, heat, and overexertion.

All Other, Medical/Surgical – Any medical or surgical condition not fitting into any category above.

Dental – Any disease of the teeth and oral cavity.
Includes: periodontal and gingival disorders, caries, and mandible abnormalities.
Excludes: dental trauma (place in an injury category).

Miscellaneous/Administration/Follow-up – All other visits to the treatment facility not fitting one of the above categories, such as profile renewals, pregnancy (initial diagnosis, prenatal care, awaiting evacuation), immunizations, prescription refills, and physical exams or laboratory tests for administrative purposes.

Definable – An additional category established for a specific deployment based upon public health concerns (e.g., malaria, dengue, airborne/HALO injuries, etc.). Authorization to use and case definition of this category resides at no less than the JTF Surgeon/Task Force Surgeon level of authority (assumes consultation with appropriate preventive medicine personnel).

APPENDIX J: CRUDE HOSPITALIZATION RISK FACTORS

Variable		Crude OR	95% CI	p-value
Squadrons 320, 321, 322, 323, 324,331				
	All other squadrons	REF		
	320	1.661	1.291, 2.137	**p < 0.001**
	321	1.083	0.819, 1.434	
	322	0.630	0.455, 0.871	**p < 0.05**
	323	0.736	0.526, 1.030	
	324	1.107	0.830, 1.476	
	331	0.896	0.662, 1.213	
Age Groups	18-20	REF		
	21-22	0.928	0.727, 1.183	
	>=23	0.686	0.508, 0.925	**p < 0.05**
Gender	Male	REF		
	Female	0.605	0.461, 0.794	**p < 0.001**
Nonrespiratory visits	0	REF		
	>=1	0.796	0.635, 0.998	**p < 0.05**
All visits	0	REF		
	>=1	32.078	10.276, 100.138	**p < 0.001**
All visits*	0	REF		
	>=1	0.669	0.526, 0.850	**p < 0.05**
Respiratory visits*	0	REF		
	>=1	0.582	0.457, 0.741	**p < 0.001**
Clinic Visit as Outcome				
Variable		**Crude OR**	**95% CI**	**p-value**
Squadrons 320, 321, 322, 323, 324,331				
	All other squadrons	REF		
	320	2.44	1.924, 3.085	**p < 0.001**
	321	0.804	0.670, 0.965	**p < 0.05**
	322	0.785	0.657, 0.939	**p < 0.05**
	323	0.920	0.755, 1.121	
	324	0.679	0.565, 0.815	**p < 0.001**
	331	1.263	1.030, 1.549	**p < 0.05**

* Excludes respiratory visits within four days of hospitalization and all visits following hospitalization among those who were hospitalized.

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APPENDIX K: HOSPITALIZATION RISK FACTORS, ADJUSTED

Variable		Adjusted OR *	95% CI	p-value
All Visits**				
Squadron 320	0	REF		
	>=1	0.315	0.189, 0.523	**p<0.001**
Squadron 321	0	REF		
	>=1	0.787	0.452, 1.369	
Squadron 322	0	REF		
	>=1	0.960	0.478, 1.925	
Squadron 323	0	REF		
	>=1	1.092	0.507, 2.353	
Squadron 324	0	REF		
	>=1	0.683	0.394, 1.185	
Squadron 331	0	REF		
	>=1	0.790	0.402, 1.552	
Respiratory Visits**				
Squadron 320	0	REF		
	>=1	0.606	0.380, 0.966	**p <0.05**
Squadron 321	0	REF		
	>=1	0.803	0.481,1.434	
Squadron 322	0	REF		
	>=1	0.491	0.238, 1.012	**p =0.054**
Squadron 323	0	REF		
	>=1	0.495	0.248, 0.989	**p< 0.05**
Squadron 324	0	REF		
	>=1	0.374	0.191, 0.733	**p< 0.01**
Squadron 331	0	REF		
	>=1	0.660	0.351,1.243	

* Adjusted for age category and gender

**Excludes respiratory visits within four days of hospitalization and all visits following hospitalization among those who were hospitalized.

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APPENDIX L: INTERVENTION RECOMMENDATIONS

Hygiene

- Personal hygiene
  - Hand washing
    - Readily accessible facilities at all latrines
    - Eliminate barriers to use of sinks
    - Move male FTX hand-washing unit
  - Tissues to reduce droplet spread (makes sense)
    - Allow and encourage disposable tissues in classroom, sleeping areas, non-formal formations
  - Showering (questionable efficacy for respiratory pathogens)
    - Encourage daily shower for all
- Antimicrobial hand wipes:
  - One study done at Lackland in 1997 showed a significant 1/3 reduction in URI incidence (first clinic visits)
  - Recommended active ingredient: *PCMX*
- Randomized (by squadron) prospective study of effectiveness of hand wipes
  - Only way to tell if it helps
  - Issue at dining facility three times a day, enforce use
  - Consider competing active ingredients

IAQ (pending BEE comments)

- Improve IAQ (see CO_2 tracings in handout)
  - (Theoretical benefit for Ad, but industry standards are being significantly exceeded in RH&Ts, particularly classrooms)
  - Meet ASHRAE standards in all indoor settings: CO_2<1000ppm (AF rec: <600ppm)
    - Advocate CO_2 demand ventilation systems for classrooms (already programmed by CE)
  - More measurements would be helpful
    - There are 120 dorms, 54 classrooms
    - IAQ at Warrior Week sites is also unknown

Ongoing Surveillance

- Existing surveillance system is inadequate
  - Relies on hand kept logs at trainee clinics
  - As is, ADS is useful, but not designed as surveillance tool; low precision, timeliness, can't distinguish febrile cases
  - Admissions OK, but now less predictable
- Warrior Week using MS-T as "sentinel" site
- Actively monitor cases during and after interventions
- Advocate deployment of "ROMER" throughout trainee clinics
- One NHRC-funded FTE

Vaccine Advocacy

- The only intervention shown to be effective

- Army and Navy medics have been advocating for re-instatement of vaccine production
- Air Force has not had an apparent big Ad problem, so has not been weighed in
- Obviously the situation has changed!
- IOM, AFEB, other councils

Fomites

- Minimize potential for fomite transmission (Contribution questionable)
  - For common objects such as hand rails, door knobs: switch from current alcohol-based spray to one with residual effects: product recommendation *pending*
  - Eliminate sign-in at chow hall
  - Cover canteens at night
  - No sharing of items that touch the mouth

Access to Care

- Care-seeking (theoretical benefit)
  - Minimize stigma of going to sick call
    - MTIs vs. Trainees
  - Though no specific curative treatment is available, easier access **may** help identify those at higher risk or infectivity (actively producing droplets) for admission

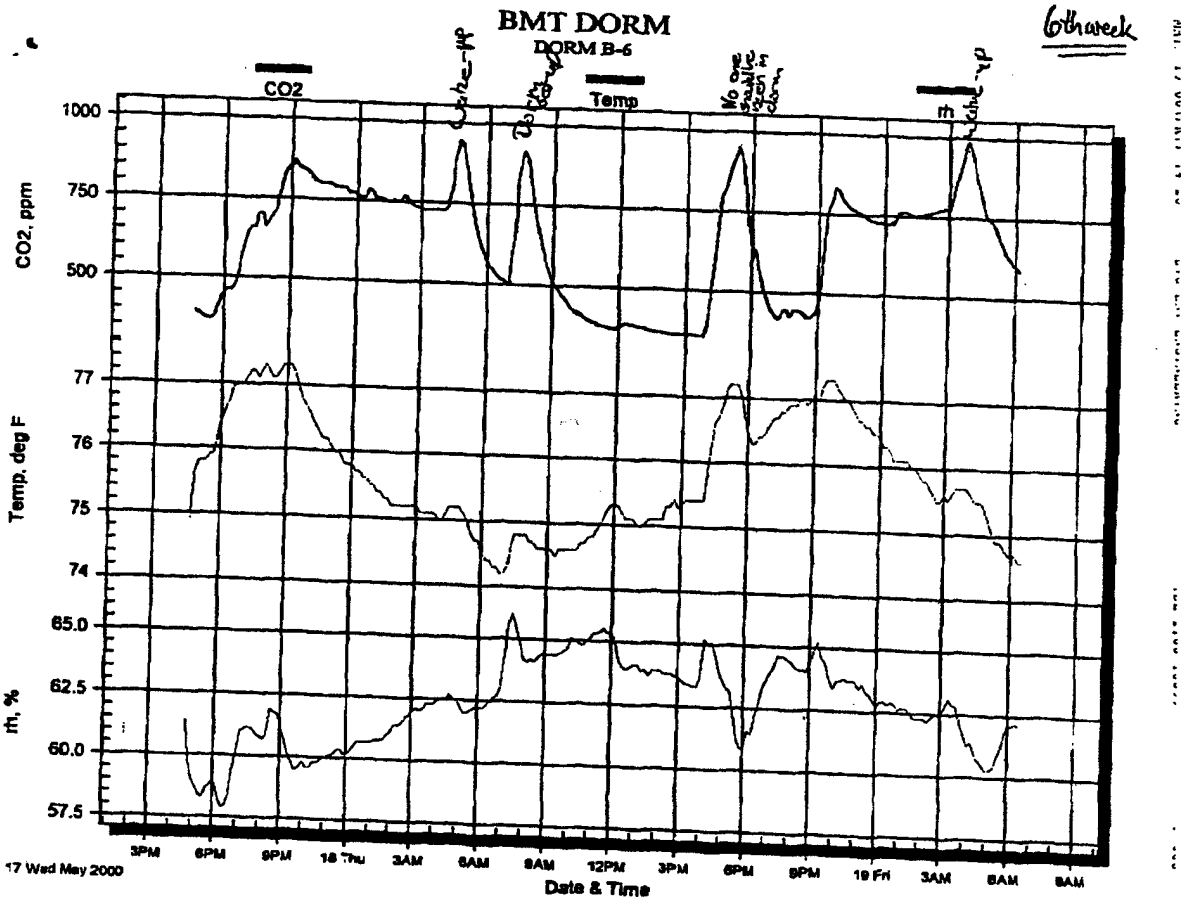
Cohorting

- Social
  - Minimize mixing of flights
    - Only well trainees to watch over baby flights
  - Drastic measures not recommended: restricted chapel congregations, use of common telephones, theater/BX
- Medical
  - Maintain 'inpatient' ward for significantly ill trainees
    - Provider judgement OK
  - Segregate "ill" trainees in waiting areas
    - Face masks upon entry if self-identified with cough, sneezing
    - Physically separate waiting areas

Other Considerations

- Maintain chosen interventions vigorously for at least 2 months to allow "washout" of trainee populations
  - Requires organizational energy to maintain
- Monitoring of clinical spectrum
  - Beware clinical complacency, potential for adverse nosocomial events
  - Anecdotes about increasing cases of lobar pneumonia?
  - Tracking adenovirus culture positive proportions
- Novel intervention possibilites?
  - Microbicide showering soaps, zinc lozenges, others?

APPENDIX M: DORMITORY INDOOR AIR QUALITY TRACING



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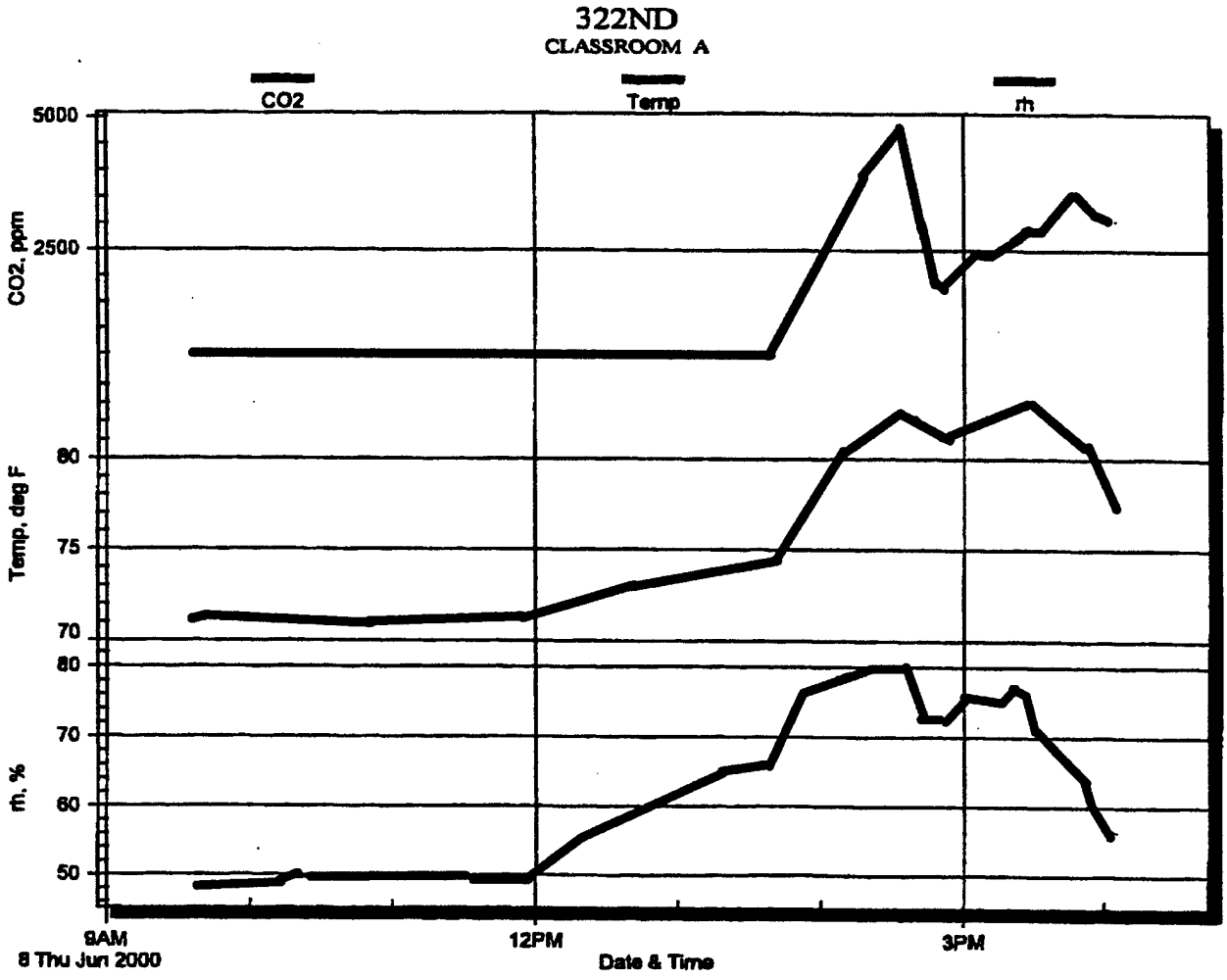
APPENDIX N: CLASSROOM INDOOR AIR QUALITY TRACING



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APPENDIX O: SELECTED RESULTS FROM BMT QUESTIONNAIRE

(Questionnaires distributed to all trainees present on Thursday 4 May 2000 during Warrior Week. n=413. Overall response rate unknown but felt to be at or near 100% under the circumstances. Denominators are not equal due to occasional non-response.)

To your knowledge have you been around anyone with a respiratory illness during your training?
YES: 331/403 (82.1%)

How often do you share a canteen?
Rarely/never: during Weeks 1-4: 366/384 (95.3%)
during Warrior Week 357/402 (88.8%)

How often do you share snacks, drinks, utensils?
Rarely/never during Weeks 1-4: 346/384 (90.1%)
during Warrior Week: 333/393 (84.7%)

How often do you share a towel?
Rarely/never during Weeks 1-4 351/381 (92.2%)
During Warrior Week 380/408 (93.1%)

How often do you share your gas mask?
Rarely/never: 377/408 (92.4%)

Is your use of sinks limited to avoid having to clean them?
YES: 76.3%

During training, how often do you receive instruction on hygiene?
Many times: 66% Few times: 21% One time: 4% Never: 9%

Statistically significant difference in reported hand-washing frequency by squadron

Report of having respiratory symptoms during training was significantly associated with the following:
male gender: OR 1.33 (1.10, 1.59)
wash hands rarely/never after sneezing: OR 1.4 (1.1, 1.7)
wash hands rarely/never after coughing: OR 1.7 (1.3, 2.3)
high stress: OR 1.3 (1.1, 1.5)

Representative Quotes From BMT Questionnaires, Open-Ended Section

Reluctance to go to clinic for fear of recycle
Hygiene is placed low on the pole [sic]
...not having people who are sick around us
... sweeping with our hands . . .
... tell us to use baby wipes instead of wetting a sink
Although facilities are clean trainees are sacrificing their own cleanliness to keep it that way
Being ordered to dust down the entire latrine with bare hands
Better medication than just a cold pack
Each trainee should be allowed, at a minimum, to carry a trial-size hand sanitizer
I've seen people wash their hands in toilet water because the latrine crew was going to have an inspection
Leave us alone it only makes us stronger
Not able to cover mouths when coughing or sneezing in formation
Not making going to sick call such a big deal
People coughing on other people's neck and side of face in tight formations

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APPENDIX P: SUMMARY OF RESULTS FROM THE MTI OPEN-ENDED QUESTIONNAIRE

22 questionnaires completed
10 Warrior Week MTI's
12 Street MTI's

1/22	4.5%	need better handwashing facilities
4/22	18%	more briefings on hygiene/handwashing
1/22	4.5%	grow grass wherever possible
2/22	9%	need better personal hygiene
3/22	14%	trainees should use hand sanitizers
3/22	14%	trainees need more time in schedule
4/22	18%	better/faster separation of sick MTI's/trainees from well MTI's/trainees
1/22	4.5%	more personnel/better care at dispensary
1/22	4.5%	increased admission of sick trainees to WHMC
1/22	4.5%	climate control in dorms- keep cooler
1/22	4.5%	vitamins
1/22	4.5%	decrease latrine inspection requirements
1/22	4.5%	more space/trainee

Some interesting comments:

"Trainee admittance to WHMC"
"Use Purell hand wash when sinks are not available"
"Trainees do not have enough time from week1-4 to wash"
"No possible way to prevent it"
"Better handwashing facilities"
"Because of close proximity, it is inevitable. In my opinion all necessary and reasonable precautions are taken"
"Allow trainees or make mandatory for all trainees to carry hand sanitizer"
"Less trainees per dorm/flight"
"If possible when instructors are sick get them out of the dorms"
"Require trainees to be free of respiratory illness prior to starting training"
"...report even the smallest of colds or flu-like symptoms"
"Quarantine the airmen when finding out they are sick"
"Not having such strict guidelines for latrine being in 'inspection' order"